141-441

TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1891.

No. 999.

THE CROSBY STEAM GAGE AND VALVE COMPANY,
APPELLANT,

vs.

THE CONSOLIDATED SAFETY VALVE COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE DISTRICT OF MASSACHUSETTS.

FILED DECEMBER 29, 1890.

LAW ASSOCIATION
—OF—
PHILADELPHIA.

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1 UNITED STATES OF AMERICA, *Massachusetts District,* } *ss:*

At a circuit court of the United States for the first circuit, begun and holden at Boston, within and for the district of Massachusetts, on Thursday, the fifteenth day of May, in the year of our Lord one thousand eight — and ninety.

Before the Honorable Le Baron B. Colt, circuit judge.

CONSOLIDATED SAFETY VALVE COMPANY, Complainants,
v.
CROSBY STEAM GAGE AND VALVE COMPANY, Defendants.
} No. 1184. Equity.

Statement as to Former Proceedings Herein.

The proceedings before this circuit court in this case, which were had previously to May 7, 1885, the date of the receipt of the mandate of the Supreme Court of the United States herein, were recorded at the October term of this court, A. D. 1880, and a transcript of the record thereof was transmitted to the Supreme Court of the United States upon the appeal of the complainants; which appeal
2 was duly entered in said Supreme Court at the October term, A. D. 1881, and was heard in said Supreme Court at the October term, A. D. 1884, the said appeal being numbered 127 upon the docket of said Supreme Court at said October term, A. D. 1884.

Proceedings in this Case from the Receipt of the Mandate of the Supreme Court Herein, May 7, 1885.

The mandate of the Supreme Court of the United States in this case was received in this circuit court at the October term, A. D. 1884, and filed on the seventh day of May, A. D. 1885, and is as follows:

Mandate of the Supreme Court of the United States.

UNITED STATES OF AMERICA, *ss:*

[L. S.] The President of the United States of America to the honorable the judges of the circuit court of the United States for the district of Massachusetts, Greeting:

Whereas lately in the circuit court of the United States for the district of Massachusetts, before you or some of you, in a cause between The Consolidated Safety Valve Company of Hartford, Connecticut, complainant, and The Crosby Steam Gage and Valve Company, defendant, No. 1184, wherein the decree of the said circuit court entered in said cause is in the following words, viz:

3 "This cause came on to be heard at this present October term, A. D. 1880, upon the pleadings and proofs and was

argued by counsel for the respective parties, and now, upon consideration thereof, to wit, April 30, 1881, it is ordered, adjudged, and decreed that the bill of complaint in this cause be, and the same is hereby, dismissed with costs for the defendants, taxed at two hundred and forty-eight dollars and sixteen cents," as by the inspection of the transcript of the record of the said circuit court, which was brought into the Supreme Court of the United States by virtue of an appeal agreeably to the act of Congress in such case made and provided, fully and at large appears;

And whereas, in the present term of October, in the year of our Lord one thousand eight hundred and eighty-four, the said cause came on to be heard before the said Supreme Court on the said transcript of record, and was argued by counsel: On consideration whereof it is now here ordered, adjudged, and decreed by this court that the decree of the said circuit court in this cause be, and the same is hereby, reversed with costs, and that the said complainant recover against the said defendant, The Crosby Steam Gage and Valve Company, four hundred and thirty-three dollars and seventy-one cents for its costs herein expended and have execution therefor.

And it is further ordered that this cause be, and the same is hereby, remanded to the said circuit court with direction to enter a decree sustaining the validity of the patent of 1866 sued on and decreeing infringement and awarding an account of profits and damages as prayed for, and to take such further proceedings as may be proper and not inconsistent with the opinion of this court.

19th January, 1885."

4 You therefore are hereby commanded that such execution and further proceedings be had in said cause, in conformity with the opinion and decree of this court, as according to right and justice and the laws of the United States ought to be had, the said appeal notwithstanding.

Witness the Honorable Morrison R. Waite, Chief Justice of said Supreme Court, the fifth day of May, in the year of our Lord one thousand eight hundred and eighty-five.

JAMES H. McKENNEY,
Clerk of the Supreme Court of the United States.

Costs of complainant:

Clerk	$156 21
Printing record	257 50
Attorney	20 00
	$433 71

A copy of the opinion of the Supreme Court in this cause, as reported in 113 U. S., 157, was filed with said mandate.

On the eleventh day of May, A. D. 1885, the following motion to amend the answer of defendants and affidavit of William A. Herrick and Joshua H. Millett were filed by defendants:

Motion to Amend the Answer of Defendants. (*Filed May* 11, 1885.)

And now the defendant moves for leave to amend the answer to the bill of complaint, filed in this cause at the May term of this court, A. D. 1879, to wit, Sept. 27, 1879, by inserting at the end of the ninth section the following words:

5 And the defendant, further answering, says that it is informed and believes said Richardson, on or about Dec. 1, 1866, assigned his said letters patent of Sept. 25, 1866, to a firm by the name of George W. Richardson & Company, of which he was a member; and while a member of said firm, prior to July 19, 1867, said Richardson entered into negotiations with one Henry Waterman, the same mentioned in the complainant's bill of complaint, for the purchase of the letters patent issued to said Waterman for a safety-valve Nov. 15, 1853, and thereupon, as a result of said negotiations, said Waterman became a member of the said firm of George W. Richardson & Company, and sold to said firm of George W. Richardson & Company said Waterman letters patent, and thereupon said firm became the owners of the said Richardson patent and the said Waterman patent, and thereafter said firm caused said Waterman letters patent to be reissued by said Waterman with an amended specification and claim, wherein and whereby there was intended to be embraced and contained, and in fact was embraced and contained, the essential and material part of the supposed invention of said Richardson, as set forth in his said patent of Sept. 25, 1866; and the said Richardson and the said Waterman, by said reissue patent, for their own purposes and advantage intended to and did subordinate the said Richardson patent of 1866 to said prior Waterman invention, all of which will appear from a comparison of said Richardson patent with said Waterman reissued patent, whereof the defendant makes profert.

And the defendant avers that upon the reissue of said Waterman patent as aforesaid said Waterman assigned the same to said

6 firm of George W. Richardson & Company by deed, dated July 19, 1867; and the defendant further says that said reissued letters patent would have expired Nov. 15, 1867, but, it is informed and believes, proceedings were had upon the part of George W. Richardson & Company aforesaid for an extension thereof, and thereupon the said reissued letters patent were extended for a term of seven years, to wit, to November 15, 1874, and the said extension bears date March 26, 1868.

Upon the procurement of said extension said Henry Waterman assigned the grant thereof to said George W. Richardson & Company by deed dated March 30, 1868, and thereafter the said George W. Richardson & Company continued the owners thereof until the expiration of the same, and asserted and maintained the said Waterman reissued patent against the public.

And the defendant avers that the safety-valve shown and described in said Waterman reissued and extended letters patent embodies in its construction and performs in its functions, as set forth in said

argued by counsel for the respective parties, and now, upon consideration thereof, to wit, April 30, 1881, it is ordered, adjudged, and decreed that the bill of complaint in this cause be, and the same is hereby, dismissed with costs for the defendants, taxed at two hundred and forty-eight dollars and sixteen cents," as by the inspection of the transcript of the record of the said circuit court, which was brought into the Supreme Court of the United States by virtue of an appeal agreeably to the act of Congress in such case made and provided, fully and at large appears;

And whereas, in the present term of October, in the year of our Lord one thousand eight hundred and eighty-four, the said cause came on to be heard before the said Supreme Court on the said transcript of record, and was argued by counsel: On consideration whereof it is now here ordered, adjudged, and decreed by this court that the decree of the said circuit court in this cause be, and the same is hereby, reversed with costs, and that the said complainant recover against the said defendant, The Crosby Steam Gage and Valve Company, four hundred and thirty-three dollars and seventy-one cents for its costs herein expended and have execution therefor.

And it is further ordered that this cause be, and the same is hereby, remanded to the said circuit court with direction to enter a decree sustaining the validity of the patent of 1866 sued on and decreeing infringement and awarding an account of profits and damages as prayed for, and to take such further proceedings as may be proper and not inconsistent with the opinion of this court.

19th January, 1885."

4 You therefore are hereby commanded that such execution and further proceedings be had in said cause, in conformity with the opinion and decree of this court, as according to right and justice and the laws of the United States ought to be had, the said appeal notwithstanding.

Witness the Honorable Morrison R. Waite, Chief Justice of said Supreme Court, the fifth day of May, in the year of our Lord one thousand eight hundred and eighty-five.

JAMES H. McKENNEY,
Clerk of the Supreme Court of the United States.

Costs of complainant:

Clerk	$156 21
Printing record	257 50
Attorney	20 00
	$433 71

A copy of the opinion of the Supreme Court in this cause, as reported in 113 U. S., 157, was filed with said mandate.

On the eleventh day of May, A. D. 1885, the following motion to amend the answer of defendants and affidavit of William A. Herrick and Joshua H. Millett were filed by defendants:

Motion to Amend the Answer of Defendants. (*Filed May* 11, 1885.)

And now the defendant moves for leave to amend the answer to the bill of complaint, filed in this cause at the May term of this court, A. D. 1879, to wit, Sept. 27, 1879, by inserting at the end of the ninth section the following words:

5 And the defendant, further answering, says that it is informed and believes said Richardson, on or about Dec. 1, 1866, assigned his said letters patent of Sept. 25, 1866, to a firm by the name of George W. Richardson & Company, of which he was a member; and while a member of said firm, prior to July 19, 1867, said Richardson entered into negotiations with one Henry Waterman, the same mentioned in the complainant's bill of complaint, for the purchase of the letters patent issued to said Waterman for a safety-valve Nov. 15, 1853, and thereupon, as a result of said negotiations, said Waterman became a member of the said firm of George W. Richardson & Company, and sold to said firm of George W. Richardson & Company said Waterman letters patent, and thereupon said firm became the owners of the said Richardson patent and the said Waterman patent, and thereafter said firm caused said Waterman letters patent to be reissued by said Waterman with an amended specification and claim, wherein and whereby there was intended to be embraced and contained, and in fact was embraced and contained, the essential and material part of the supposed invention of said Richardson, as set forth in his said patent of Sept. 25, 1866; and the said Richardson and the said Waterman, by said reissue patent, for their own purposes and advantage intended to and did subordinate the said Richardson patent of 1866 to said prior Waterman invention, all of which will appear from a comparison of said Richardson patent with said Waterman reissued patent, whereof the defendant makes profert.

And the defendant avers that upon the reissue of said Waterman patent as aforesaid said Waterman assigned the same to said

6 firm of George W. Richardson & Company by deed, dated July 19, 1867; and the defendant further says that said reissued letters patent would have expired Nov. 15, 1867, but, it is informed and believes, proceedings were had upon the part of George W. Richardson & Company aforesaid for an extension thereof, and thereupon the said reissued letters patent were extended for a term of seven years, to wit, to November 15, 1874, and the said extension bears date March 26, 1868.

Upon the procurement of said extension said Henry Waterman assigned the grant thereof to said George W. Richardson & Company by deed dated March 30, 1868, and thereafter the said George W. Richardson & Company continued the owners thereof until the expiration of the same, and asserted and maintained the said Waterman reissued patent against the public.

And the defendant avers that the safety-valve shown and described in said Waterman reissued and extended letters patent embodies in its construction and performs in its functions, as set forth in said

reissued letters patent, all that is shown and described in the said letters patent of said George W. Richardson of 1866 as new and useful in construction and operation of a safety-valve, and that the said Richardson and his firm, when they became a party to the purchase, reissue, and extension of the said Waterman patent, assented to the specification and claim of said Waterman as that of a prior inventor of a safety-valve as described by him, said Richardson, in his said letters patent of 1866, and thereby disclaimed all claim to size and proportion of the parts of the organization of a safety-valve as the same might apply to the peculiar form of his described safety-valve; and he and they also disclaimed any claim under said patent to anything beyond the special structure shown in his drawing and limited by the claim therein; and thereupon, upon the expiration
7 of said Waterman's reissued letters patent, the safety-valve described therein and the invention therein set forth was dedicated to the public.

And the defendant avers that said Richardson and his said firm and his and their successors to the title of said Richardson letters patent thereafter had no exclusive right to a safety-valve embodying the structural features and functions as described in said Waterman reissued letters patent, and especially as against the defendant whose safety-valve, alleged to infringe the said Richardson letters patent, was patented and made since the expiration of said reissued letters patent; and the said complainant took the assignment of said Richardson patent with full notice of the foregoing facts, and is in privity in estate with the said Richardson and said Waterman as to said patents and has no equity as against the defendant.

CROSBY STEAM GAGE & VALVE CO.,
By J. H. MILLETT, *Solicitor.*

BENJAMIN F. THURSTON,
J. H. MILLETT,
Of Counsel for Defendant.

Affidavit of William A. Herrick and Joshua H. Millett. (*Filed May* 11, 1885.)

Circuit Court of the United States, District of Massachusetts. In Equity.

CONSOLIDATED SAFETY VALVE COMPANY, Complainants, *v.* CROSBY STEAM GAGE AND VALVE COMPANY, Defendants.	Nos. 1184 and 1199.

8 We, Wm. A. Herrick, of Cambridge, and Joshua H. Millett, of Malden, Mass., on oath depose and say that we were the sole solicitors and counsel for the defendant in the above-entitled causes from the time of service of process upon the defendant until after the decision of said cases in the circuit court and the appeal

therefrom to the Supreme Court had been taken; that we prepared all the defendant's pleadings and took all the testimony in the cases; that the particular facts disclosed in the cross-examination of Henry Waterman on pages 415–421, inclusive, of the record (pages 321–327 of record in Supreme Court) were wholly unknown to us until such cross-examination, which took place on the last day but two of taking testimony in the cases, Oct. 26th, 1880; that the testimony in the cases was immediately thereafter closed and the defendant's brief at once prepared and the cases argued before the circuit court in the following February; that we had no question, at the time the testimony was taken nor thereafterwards, but that it was admissible under the defendant's answers for all purposes; that its effect was argued at length upon the defendant's brief, and it was claimed that the "complainants are bound by Richardson's declaration and acts in derogation of their patent while he was the owner thereof;" that no objection was made at the argument by the complainants' counsel or by the court that the testimony of Waterman above referred to was not properly before the court for all purposes whatever; that by reason of these circumstances and the further facts that the opinion of the circuit court was filed shortly after the argument, in which opinion said testimony was considered by the court and the cases decided in favor of the defendant and an appeal at once taken to the Supreme Court, it never occurred to us that there was either need of or propriety in amending the answer with reference to the facts disclosed in said testimony of Waterman until after reading the opinion of the supreme court.

Sworn to Feb. 27, 1885.

WM. A. HERRICK.
JOSHUA H. MILLETT.

9 This case was thence continued to the May term of this court, A. D. 1885, when the same came on to be heard by the court on settlement of the decree on return of the mandate and on motion to amend the answer of the defendants, and thereupon the following decree was entered:

Decree on Mandate. (*May* 18, 1885.)

1. This cause was heard at the October term, 1880, and a decree was entered on the 30th of April, 1881, that the bill be dismissed with costs, from which decree complainants appealed and gave bonds to prosecute the appeal, &c., and took up a transcript of the record to the Supreme Court of the United States; and at this October term, 1884, to wit, May 5th, 1885, the cause is remanded by the Supreme Court, with the said decree reversed, with costs, taxed at four hundred and thirty-three $\frac{11}{100}$ dollars, and instructions to enter a decree sustaining the validity of the patent sued on and decreeing infringement, and for an account of profits and damages, and for such further proceedings as may be proper and not inconsistent with the opinion of the Supreme Court of January 19, 1885.

2. And now, on reading and filing the mandate in said cause and

on motion of Mr. Thomas William Clarke, of counsel for complainants, whereof due notice has been given defendants, and on consideration thereof, to wit, this 18 day of May, 1885—

3. It is ordered, adjudged, and decreed that the said mandate of the Supreme Court be recorded; that the said appeal bonds given be cancelled; that the letters patent referred to in complainants' bill, being letters patent granted to George W. Richardson September 25, 1866, No. 58294, were good and valid letters patent;
10 that said George W. Richardson was the original and first inventor of the improvement described and claimed therein; that the defendants have infringed the said letters patent and the exclusive rights of the complainants under the same.

4. It is further ordered, adjudged, and decreed that the complainants recover of defendants the profits which they have received or made or which have accrued to them from said infringement since Feb. 15, 1879, by the manufacture, use, or sale of the improvement described and secured by said letters patent, and also the damages which the complainants have sustained thereby since said last-named date.

5. It is further ordered, adjudged, and decreed that it be referred to John G. Stetson, a master of this court *pro hoc vice*, he being agreed to by counsel as the best person therefor, to take and report to the court an account of the profits which said defendants have received or which have arisen or accrued to them from the unlawful manufacture, use, or sale of said invention, and to ascertain and report the damages, if any, which the complainants have sustained thereby, both since the date above mentioned.

6. It is further ordered, adjudged, and decreed that the complainants have execution against the defendants for their costs of appeal, taxed by the Supreme Court at four hundred and thirty-three dollars and seventy-one cents.

7. And that they also recover their costs of suit, to be taxed.

8. Either party is at liberty to apply for such further order in the cause as they may be advised.

By the court:

JOHN G. STETSON, *Clerk.*

11 On the second day of September, A. D. 1885, defendants' motion to amend answer was denied by the court. This case was thence continued from term to term to the May term of this court, A. D. 1889, when, on the fifth day of August, A. D. 1889, the following master's report was filed in this case and in case No. 1199, between the same parties:

(MEMORANDUM.—In recording the master's report certain parts of the report which relate solely to case No. 1199 are omitted, it being agreed by counsel for the respective parties that such parts can be omitted and leave the said report in a form to be easily understood so far as it relates to this case, No. 1184.

In like manner certain other parts of the master's report, which relate to damages in this case, No. 1184, are omitted, as the master

found that the complainants have suffered no damages in addition to profits to be assessed against the defendants in this case, and, the court having confirmed this finding, the complainants have taken no appeal from the decree of the court herein. The omissions are made after consultation with counsel for the respective parties, and are satisfactory to said counsel.

JOHN G. STETSON, *Clerk.*)

12 Circuit Court of the United States, District of Massachusetts.
In Equity.

CONSOLIDATED SAFETY VALVE COMPANY
v.
CROSBY STEAM GAGE AND VALVE COMPANY. } No. 1184.

On letters patent No. 58294, to George William Richardson, for improvement in steam safety-valves, dated Sept. 25, 1866.

SAME
v.
SAME. } No. 1199.

On letters patent No. 85963, to George William Richardson, for improvement in steam safety-valves, dated Jan. 19, 1869.

Master's Report. (*Filed August* 5, 1889.)

To the honorable judges of said circuit court:

These cases were commenced by the filing of a bill of complaint in the circuit court in the first cause, No. 1184, May 27, 1879, and in the second cause, No. 1199, June 2, 1879, and were heard by the circuit court Feb. 7 and 8, 1881, upon pleadings and proofs for final hearing, taken at the same time in both of said cases. The circuit court entered decrees dismissing both bills of complaint April 30, 1881. The complainants appealed from these decrees and entered their appeals in the Supreme Court at the October term, 1881. These cases were heard in the Supreme Court in December, 1884, and were decided in that court Jan. 19, 1885. The Supreme Court reversed the decree of the circuit court and remanded the cases to the circuit court, with directions to enter decrees sustaining the validity
13 of the patents sued on, decreeing infringements of both patents, and directing accounts to be taken of profits as to both patents as prayed for, and to take such further proceedings as may be proper and not inconsistent with the opinion of the Supreme Court. The circuit court, on receipt of the mandates of the Supreme Court, entered decrees, as thereby directed, sustaining the validity of both said patents and referring the cases to me, as master, to take and report to the court accounts of the profits which the defendants have received or which have arisen or accrued to them from the unlawful manufacture, use, or sale of the invention described and

claimed in each of said patents, and to ascertain and report the damages, if any, which the complainants have sustained thereby, both since Feb. 15, 1879, the time when the title to each of said patents became vested in the complainants. The mandates of the Supreme Court were received by the circuit court May 7, 1885, and the terms of the decrees of the circuit court pursuant to the said mandates were settled May 18, 1885.

Proceedings before me under the decrees and orders of reference began at once and were continued as rapidly as the convenience of counsel would permit. The cases were submitted to me upon the final arguments of counsel, Dec. 7, 1887.

The proceedings before me were briefly as follows:

1. May 25, 1885, I ordered in each case that the defendants have till June 16, 1885, to make and file with me an account of the profits which they had made by their infringement of the complainants' invention during the period as to which they were required to account, and on the last-named day the defendants filed papers entitled "Defendants' Account in No. 1184" and "Defendants' Account in No. 1199." These papers were subsequently amended to the forms of the papers hereto annexed, marked "Defendants' Account in No. 1184, J. G. S., master," and "Defendants' Account in No. 1199, J. G. S., master." Subsequently the defendants filed schedules, being transcripts from their sales books, showing in detail the names of purchasers, the dates of sale, the numbers of valves sold, and the class and price of each valve sold, covering the sales embraced in their accounts.

2. The defendants' treasurer, George H. Eager, and their superintendent, George H. Crosby (also one of defendants' directors),
14 were examined at great length as to the making up of the accounts filed and as to the methods of business of the defendants during the periods respectively covered by the accounts.

3. Sept. 1, 1885, the complainants filed an analysis of defendants' account and a charge in profits and damages in both cases, and Oct. 24, 1885, the defendants filed a discharge in each case, and under the pleadings as thus constituted evidence was submitted by both parties, but before the evidence was closed the complainants modified their analysis and charge to the form of the paper hereto annexed, marked "Complainants' Analysis of Account and Modified Charge in Profits and Damages in each of said two cases, J. G. S., master," and the defendants filed a reply thereto, which is hereto annexed, marked "Defendants' Reply to Complainants' Analysis, J. G. S., master." The defendants also filed a discharge in each case, an additional discharge, and an amended and additional discharge. These papers are hereto annexed, marked "Defendants' Discharges, J. G. S., master."

After the pleadings were completed as above indicated additional evidence was given before me, and it was understood by counsel for both parties, and so ruled by me, that all the evidence before me should apply to the pleadings as finally constituted, so far as competent and material under said pleadings. All the evidence before

me was reduced to writing, but I do not make it a part of this report, as I do not deem it advisable to do so.

4. At the final argument before me counsel for both parties presented requests for findings, and I have these requests before me as I make my draft report.

Profits.

It appeared from the evidence before me that the defendants in introducing their valves sent out from time to time valves on consignment or without receiving orders for them, as well as valves for which they had received orders. Some of the valves so sent out were returned, some were lost, and some had allowances made on them from the prices charged. In keeping their accounts the defendants treated all these valves as sold and credited on the prices charged therefor for valves returned bad debts and for allowances according as the valves were returned or never paid for, or paid for at a discount from the prices first charged in their accounts. In defendants' account, as filed in these cases, all the valves so sent out are included in sales. They are also included in the schedules of costs of valves manufactured, and when returned the prices at which they were charged are claimed as allowances on account of valves returned. This is manifestly wrong. The defendants should not have credited the sale of valves not sold but returned; they should not have charged the cost of such valves in their schedules of costs, and they should not have credited themselves with losses from valves returned. In other words, the entire transaction should have been cancelled.

When such valves, sent out without being sold, were subsequently sold at a discount without being returned, the defendants are entitled to deduct the discount from the sales. It is not exactly the same thing to charge back the discounts as special expenses, as deducting the discounts from sales would affect the percentages of general expenses to be allowed defendants, and consequently the amount of general expenses to be allowed.

It also appeared from the evidence that defendants could not verify their calculations as to costs of valves by any contemporary memoranda. The costs given by defendants in their accounts were estimates based upon information furnished by their superintendent, George H. Crosby, to enable the defendants to make up their accounts.

Upon this state of facts, briefly stated above, the complainants claimed that it was fair to make up the accounts in these cases upon a different basis from that adopted by defendants, and to take the lowest selling prices of the defendants' valves for each stated period of the accounting as the criterion of delivered cost for that period, and to estimate the defendants' profits upon those valves which were sold at higher prices than such lowest selling prices.

In this connection the complainants requested me to make the following findings:

Eighth. The master is requested to find as a fact that the defendants' method of making up their accounts does not show accurately

the number of valves made by them, but that the valves
16 which were returned to them are charged on their accounts as manufactured not only at the time when they were first sent out, but also at the time when they were afterwards sent out, if they were sent out afterwards, and that, consequently, the true way to ascertain the number of valves made by the defendants for which they ought to account in this proceeding is to ascertain it by deducting the valves returned from the valves sent out and charging in the schedule of costs only the net amount.

He is also requested to find as a matter of law that each sale of a valve is an independent and separate infringement, and each sale of a valve is entitled, in this proceeding, on the question of profits, to be considered separately; and, consequently, if a valve was not paid for or had an allowance or commission made upon its price, so as to reduce the profit thereon to nothing, it is not to be considered in making up the account of profit. Defendants are to bear their own losses as they occur, but complainants are entitled to reap the profits, if there are any; not the net profits resulting from setting off the individual debts of bad customers against the good individual indebtedness of others, but that each transaction should be considered as a separate transaction, and hence that the number of valves on which complainants are to be allowed costs of manufacture are the number of valves which were paid for, and not the number of valves which were sent out, some of which were returned and some of which were lost. That the number of valves made for which the defendants are to account in this proceeding are as stated in the complainants' charge in profits on page 76 and following.

Ninth. The master is also requested to find as matter of law that the defendants are concluded, by the selling price established by them, from a contention that said price did not yield to them the costs of their manufacture and sale; that where a man undertakes to deal with the property of another and keeps no accurate account of it, and has no contemporary memorandum of it, he cannot be heard to say that he has lost money by the dealing.

He is also requested to find, as matter of fact, that the cogency of the evidence which results from the established selling price of a large part of the product, as to the cost of making and marketing that product being a cost not exceeding the selling price, is so great as to preponderate over any and every calculation made to use afterwards and unsupported or contradicted by the only contemporary memoranda.

I agree with the statement which complainants make in the first paragraph of their request "eighth." I do not concur in their statements in the second paragraph. The defendants in these cases carried on the manufacture and sale of valves as a continuous business.

The valves which they sold at profit and those which they
17 sold at a loss are intermingled. There is no considerable period during which they sold valves at a profit with no losses, nor is there any considerable period during which they sold valves continuously at a loss. They are entitled to have their entire valve business taken into consideration in estimating their profits

from the infringements complained of, if they have given me the means of determining those profits from their accounts filed and the explanations and evidence which they have offered in relation thereto, and, after a careful consideration, I find that I can revise the accounts of profits as presented by the defendants from the evidence before me so that they shall be true accounts of the profits which the defendants have made by their infringements complained of.

As to complainants' contention that I ought not to accept these accounts, because the costs are not made up from contemporary memoranda, I am obliged to say that, although contemporary memoranda are very valuable in such matters, they are not the only means of arriving at costs in an accounting. In these cases the defendants gave a detailed itemization of costs, based, as they alleged, on the recollection of their superintendent, Mr. Crosby, and it was competent for the complainants to offer evidence tending to show that Crosby's recollection was at fault, or that the calculations based on that recollection and other data were erroneous. There was, indeed, some evidence tending to show this, but not sufficient to cause me to discard the costs as given by the defendants in the costs schedules of their accounts. From the whole evidence, I find the costs of valves for the several periods correctly given by the defendants.

Having come to the conclusion that the accounts are correctly made up on principle, although erroneous in certain details, which I am able to correct from the evidence before me, I have proceeded to make the necessary corrections, and have summarized the results as to sales and costs in Master's Schedules A and B, hereto annexed. Referring to these schedules for my method of making the calculations, I make the following findings:

1. The sales by the defendants of infringing valves, stated in periods corresponding to those adopted by the defendants in making their accounts, were as follows:

18	1st	period,	Feb. 15, 1879,	to	May 1, 1880	$29,749	53
	2d	"	May 1, 1880,	"	May 1, 1881	37,110	12
3d	period,	May	1, 1881,	to	May 1, 1882	65,436	65
4th	"	May	1, 1882,	"	May 1, 1883	58,573	48
5th	"	May	1, 1883,	"	Sept. 25, 1883	24,781	45
6th	"	Sept.	25, 1883,	"	May 1, 1884	28,703	95
7th	"	May	1, 1884,	"	Jan. 31, 1885	27,079	90

Total sales from Feb. 15, 1879, to Sept. 25, 1883, were $215,651 23
" " " Jan. 31, 1885, " 271,435 08

2. The costs of infringing valves, made and sold by defendants for the corresponding periods, were as follows:

1st	period,	Feb.	15, 1879,	to	May 1, 1880	$15,004	52
2d	"	May	1, 1880,	"	May 1, 1881	19,412	77
3d	"	May	1, 1881,	"	May 1, 1882	38,433	16
4th	"	May	1, 1882,	"	May 1, 1883	30,215	00

5th period, May 1, 1883, to Sept. 25, 1883		$12,178 77
6th " Sept. 25, 1883, " May 1, 1884		14,691 48
7th " May 1, 1884, " Jan. 31, 1885		13,617 38
Total costs from Feb. 15, 1879, to Sept. 25, 1883, were		$115,244 22
" " " Jan. 31, 1885, "		143,553 08

The general expenses of the defendants were stated by them in a general expense account in corresponding periods as follows: (1) $21,626.75, (2) $27,605.39, (3) $30,059.22, (4) $43,029.63, (5) $18,622.69, (6) $28,341.54, (7) $32,579.21. The total sales of the defendants were stated by them in an exhibit total sales in corresponding periods as follows: (1) $88,458.50, (2) $101,087.62, (3) $157,078.27, (4) $176,997.11, (5) $70,288.61, (6) $107,667.71, (7) $99,314.65.

3. Calculating the percentages of the valve sales to the total sales of the defendants and ascertaining therefrom the amounts of general expenses chargeable to the valve business for the said several periods, I find the percentages and amounts to be as follows:

1st period, 33.63 % of $21,626.75, or		$7,273 08
2d " 36.71 % " 27,605.39, "		10,133 94
3d " 41.66 % " 30,059.22, "		12,522 67
4th " 33.09 % " 43,029.63, "		14,238 50
5th " 35.26 % " 18,622.69, "		6,566 36
6th " 26.66 % " 28,341.54, "		7,555 85
7th " 27.27 % " 32,579.21, "		8,884 35
Total general expenses to valves, Feb. 15, 1879, to Sept. 25, 1883, were		$50,734 55
Total general expenses to valves, Feb. 15, 1879, to Jan. 31, 1885, were		67,174 75

19 **4.** I find that the defendants are entitled to allowances on their valve business on account of certain of the items which they have placed in a column of profit and loss in their account of valves returned, etc., being the same account to which I have referred in my Schedules A and B. These allowances are set forth in detail in master's Schedule C hereto annexed. For the period covered by the accounting in No. 1184 they amount to $565.78 and for the period covered by the accounting in No. 1199 they amount to $539.28.

I now come to a consideration of the special expenses claimed by defendants under the headings IV in their accounts filed.

5. I allow item 1, cost of patterns made for valves and parts, in each case—in 1184, $2,924.23; in 1199, $3,337.24.

The one-half salary of George H. Crosby and the one-half salary and expenses of George E. Boyden, item 2 in each case, should not, in my judgment, be allowed as a special expense, but should be included in general expenses, of which the valve business should bear its proportion. Crosby was the general superintendent and Boyden was a general salesman of the defendants. They both

undoubtedly gave special attention to the valve business, but, on the whole evidence, I see no sufficient reason for taking one-half Crosby's salary and one-half Boyden's salary and expenses from general expenses and allowing them as special expenses in making and selling valves. Such apportionment is entirely arbitrary, and a corresponding apportionment of other general expenses might or might not materially change the general result. I have, however, not placed these items in general expenses in my calculations heretofore, thinking it advisable to deal with these items specially, so that, if my decision thereon should need revision, such revision could be had without disturbing my other calculations and without a special reference of these cases for that purpose. I now assign to the valve business portions of these items bearing the same relation to the whole of these items that the total valve sales for the periods respectively bear to the total sales for the periods respectively.

6. I allow of item 2 one-half salary of George H. Crosby, in 1184 $2,307.20, and in 1199 $2,838.29, and of the same item 2 one-half salary and expenses of George E. Boyden, in 1184 $398.25, and in 1199 $501.47.

7. I allow items 3, 4, 5, and 6, as claimed, amounting, in 1184, to $565.01, and in 1199 to $1,134.92.

Item 7 is for modification and reconstruction of iron valves. The costs of the reconstructed valves have already been charged in the costs of valves for the periods in which the reconstruction, so called, took place. The old valves were destroyed and a salvage made of such parts as were of value or could be used, and new valves were made and their full costs charged in the accounts of defendants. This item 7 is a claim for the cost of the destroyed valves (whether with or without an allowance for salvage I am unable to say) and should not be allowed. It comes clearly within the reasoning of Judge Shepley in his opinion in Graham *v.* Mason, 1 Holmes, 88.

8. I disallow item 7—cost of modification and reconstruction of iron valves—in each case.

Item 8 relates to commissions and discounts. So far as these relate to specific valves which I could trace, the commissions and discounts have been deducted from the costs of such specific valves and should not be allowed here. There were, however, certain commissions or discounts claimed by defendants in their account of valves returned, etc., which I have not been able to classify as relating to specific valves. The evidence before me as to these is unsatisfactory, and, without further explanation, I do not feel justified in allowing them. At the same time I do not feel certain that they ought not to be allowed. I therefore will permit the defendants to file with me any explanations as to these commissions or discounts which they may deem proper within the time which I name in my notice to counsel as the time during which I shall retain this first draft of my report in the master's office. These commissions or discounts are numbered in defendants' account of valves returned, etc., as follows:

169.	Ripley & Kimball	$44 50
201.	Commissions paid L. G. Tillotson	388 00
272.	Frick & Co., advertising	35 00
282 to 286.	W. Dixie, commissions	774 70

21 Upon the evidence now before me I make the following finding:

9. I disallow all of items 8, as claimed in defendants' accounts.

There is one other item claimed by defendants in their account of valves returned, etc., which I have not been able to dispose of satisfactorily, namely, 196, Dickson M'f'g Co., valves returned, $20. As to this item the defendants may file explanations within the time limited as before, and I will deal with it as I shall then deem to be just.

10. I allow the amounts claimed by defendants in the summaries to their accounts, proportion of interest paid, namely, in 1184, $340.07, and in 1199, $342.97.

11. I allow the amount claimed by defendants in the summary to their account in No. 1184, amount due to Meady's patent lever, $318 45.

12. I disallow the amounts claimed by defendants in their summaries to their accounts, amount paid in litigation concerning valves.

I am now able to state the profits which the defendants have made from their manufacture and sale of valves containing the complainants' patented improvements for each of the periods of the accountings in these cases, and I have done this in master's Schedules D and E, hereto annexed. Referring to these schedules for my method of making the calculations, I make the following findings:

13. The total profits which the defendants derived from their manufacture and sale of steam safety-valves containing the improvement described and claimed in letters patent No. 58294 to Richardson (being the patent declared on in No. 1184) from Feb. 15, 1879, to Sept. 25, 1883, amount to $42,741.47.

14. The total profits which the defendants derived from their manufacture and sale of steam safety-valve- containing the improvement described and claimed in letters patent No. 85693 to Richardson (being the patent declared on in No. 1199) from Feb. 15, 1879, to Jan. 31, 1885, amount to $51,953.08.

In this accounting in No. 1184 for the period from Feb. 15, 1879, to Sept. 25, 1883, I attribute the entire commercial value of
22 the valves manufactured and sold by the defendants to the improvement covered by Richardson's patent of 1866. Richardson's invention, as described and claimed in that patent, revolutionized the art of relieving steam-boilers from steam pressure rapidly approaching the dangerous point. It made effective for that purpose—rapidly and with comparatively small loss of steam—apparatus described in other patents, which very nearly embodied

Richardson's invention, but did not actually contain it. The Supreme Court in these cases has defined this invention, and has declared it to be a vital one—a life-giving principle to structures very nearly approaching but not quite containing an embodiment of Richardson's discovery.

It was contended before me that none of the complainants' valves of commerce contained this invention of Richardson, but, upon the whole evidence, with specimens of all the different valves put on the market by the complainants before me, I find that they all contained Richardson's improvement of 1866. The Supreme Court has decided in these cases that the defendants' valves contain this invention, and it is under this decision that the accounting in No. 1184 is before me. Eliminate this invention from the defendants' valves and they would be commercially worthless. No substitute for this invention has been suggested to me, and I know of none which the defendants could have used in its place to have made their valves of commercial value. The defendants claim that some of the profits which they have made are due to the peculiar form of their valves, but the form which they used in making their valves was the form in which they clothed the Richardson invention, the life of their valves, and without that life the Crosby form is worthless.

The defendants claimed before me that the complainants, in the accounting in 1184, which relates only to the Richardson patent of 1866, should prove specifically the value of the invention secured to them under that patent as used by the defendants, and that, as it was claimed by complainants (and the Supreme Court has so decided) that defendants used also Richardson's invention of 1869, the value of the invention secured to the complainants by the 1869 patent must be determined and not made an element in the recovery to be had under the accounting in 1184. I have no means
of determining the value of that invention as used by the
23 defendants from Feb. 15, 1879, to Sept. 25, 1883, or of stating in dollars and cents how much of the profits of the defendants during that period is due to that invention. The complainants claimed that during that period all the profits of the defendants were due to the Richardson invention of 1866, and as the Richardson invention of 1869 belonged also to the complainants and as the complainants and defendants were respectively the same in each case, 1184 relating to the said invention of 1866 and 1199 relating to the invention of 1869, and as the said period from Feb. 15, 1879, to Sept. 25, 1883, was included within the period to be covered by the accounting in each case, no injustice is done the defendants in acceding to the complainants' claim in this regard, and this is especially so in view of the fact that the defendants claimed that the adjustable device as shown in the Richardson patent of 1869 is worthless as such, and that the cost of the Crosby valve is less without the said so-called adjustable ring and is a better and more useful safety appliance.

General Findings as to Profits in 1184.

15. I find that the complainants are entitled to recover of the defendants forty-two thousand seven hundred and forty-one dollars and forty-seven cents ($42,741.47) as and for the profits received by the defendants from their infringement of letters patent No. 58294 (being the patent declared on in No. 1184), from Feb. 15, 1879, to Sept. 25, 1883.

I have heretofore determined the profits which the defendants made from their valve business from Feb. 15, 1879, to Jan. 31, 1885, but I am unable to determine from the evidence before me what portion of these profits, if any, is attributable to the Richardson invention of 1869, declared on in the second case before me, No. 1199.

* * * * * * *

24 *General Finding as to Damages in* 1184.

16. I find that the complainants have suffered no damages in addition to profits to be assessed against the defendants in this case, No. 1184.

* * * * * * *

Respectfully submitted,

JOHN G. STETSON, *Master.*

Master's Schedule A (Sales).

(1.)

Sales as reported in defendants' accounts, 1st period, Feb. 15, 1879, to May 1, 1880	$30,317 90
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (1) $35. (3) $30. (4) $25. (5) $20. (6) $30. (7) $15. (8) $20. (10) $70. (18) $36. (27) $4.50. (35) $5. (44) $25. (71) $70. (103) $35. (110) $25. (195) $32.50 (274) $20. (275) $30. (277) $40. (279) $3.12 (280) $34.50	605 62
	$29,712 28
Add cash sales as reported	19 75
	$29,732 03
Add sale of one 2-inch valve to Portland Machine Works, not included in sales reported	17 50
	$29,749 53

25 **(2.)**

Sales as reported in defendants' accounts, 2d period, May 1, 1880, to May 1, 1881		$37,729 85
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (11) $30. (12) $8. (13) $5. (14) $15. (15) $30. (16) $3. (17) $30. (19) $25. (20) $20. (21) $2.50 (23) $70. (24) $16. (25) $5. (26) $4. (28) $12. (29) $5. (34) $9. (37) $10.50 (49) $11. (178) $25. (179) $70. (276) $.60 (278) $26. (279) $3.13 (281) $10. (288) $168. (293) $6. (294) $20		639 73
		$37,090 12
Add cash sales as reported		20 00
		$37,110 12

(3.)

Sales as reported in defendants' accounts, 3d period, May 1, 1881, to May 1, 1882		$67,020 10
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (31) $5. (32) $3. (33) $18. (36) $15. (38) $11.70 (39) $20. (40) $46. (41) $20. (42) $6. (43) $2. (45) $10. (46) $60. (47) $5. (48) $24. (50) $20. (51) $25.50 (52) $30. (53) $28. (54) $8. (56) $10. (57) $16. (58) $48.75 (59) $175. (60) $22.75 (61) $2.50 (62) $3. (63) $32. (64) $50. (65) $28. (66) $8. (67) $4. (68, 69) $34. (77) $6.50 (78) $7.50 (79) $1.50 (80) $44. (82) $22.50 (84) $9. (85) $6. (87) $20. (102) $15. (108) $12.25 (119) $10.75 (139) $22.75 (155) $9. (156) $17.50 (183) $33. (186) $84. (187) $72. (188) $36. (189) $12. (190) $63. (191) $15. (192) $135. (287) $8. (289) $48. (290) $16. (291) $19.50 (292) $1. (295) $7.50 (296) $2.50 (303) $8. (311) $12. (326) $31.50 (327) $18. (331) $9		1,626 45
		$65,393 65
Add cash sales as reported		43 00
		$65,436 65

26 **(4.)**

Sales as reported in defendants' accounts, 4th period, May 1, 1882, to May 1, 1883		$61,738 43
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (72) $5. (74) $6. (75) $1.50 (76) $10. (81) $5.50 (82) $45. (83) $54 (86) $4.80 (88) $60. (89) $15. (90) $1.		

(91) $3. (92) $5.25 (93) $168. (94) $50.75 (95) $12. (96) $40. (97) $1.38. (98) $18. (99) $4.80 (100) $55. (101) $27. (104) $2.50 (105) $40. (106) $1.50 (107) $6. (109) $87.60 (111) $70 (112) $22.50 (113, 114) $10. (115) $19.50 (116) $21. (117) $3.75 (118) $3.50 (120) $22.75 (121) $21. (122) $2. (123) $288.60 (124) $60. (125, 126, 127, 128) $92.50 (129) $131. (134) $3.75 (135) $87.50 (136) $93.75 (142) $4. (143) $5. (150) $37.50 (158) $40. (168) $14. (170, 171) $89.25 (184) $16.45 (185) $99. (193) $90. (198, 199, 200) $161. (247) $50. (297) $2. (298) $1.20 (299) $1.50 (300) $9. (301) $12. (302) $.60 (304) $5.75 (306) $14.40 (307) $52 (308) $39. (309) $270. (310) $166.25 (310) $45. (313) $5. (314) $60. (316) $20. (319) $24. (320) $22. (321) $18. (322) $30. (323) $3. (328) $17.50 (329) $18 ---------- 3,262 70

$58,475 73

Add cash sales as reported ---------- 97 75

$58,573 48

(5.)

Sales as reported in defendants' accounts, 5th period, May 1, 1883, to Sept. 25, 1883 ---------- $25,694 00

Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (130) $3.20 (131) $2. (132) $6. (133) $42. (137) $22. (138) $40. (140) $30. (141) $15. (144) $2.80 (145) $32. (146) $20. (147) $195. (148) $12. (149) $6. (151) $19.50. (152) $13.40. (153) $10. (157) $20. (159, 160, 161) $124. (162, 163) $150. (164) $1. (165) $13.50. (166) $4. (167) $61.50. (181,182) $48.65. (255) $15. (312) $4. (324, 325) $37.50. (332) $20. (333) $3.50. ---------- 973 55

$24,720 45

27 Add cash sales as reported ---------- $58 50

$24,778 95

Add sale of one 1-inch valve to J. H. Millett, not included in sales reported ---------- 2 50

$24,781 45

* * * * * * *

28 *Master's Schedule B (Costs).*

(1.)

Costs as reported in defendants' accounts, 1st period, Feb. 15, 1879, to May 1, 1880	$15,198 48
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (1) $14. (4) $17. (5) $10.26 (8) $10. (10) $28. (18) $23. (27) $2.50 (35) $2.50 (44) $10.11 (103) $14. (110) $10.11 (274) $10.11 (275) $30. (287) $25.	206 59
	$14,991 89
Add cost of valves sold for cash	7 50
	$14,999 39
Add cost of one 2-inch valve sold Portland Machine Works, not included in costs reported	5 13
	$15,004 52

(2.)

Costs as reported in defendants' accounts, 2d period, May 1, 1880, to May 1, 1881	$19,614 76
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (11) $14.58 (12) $3.13 (13) $2.43 (14) $7.29 (17) $13.50 (20) $11.25 (23) $26.30 (24) $6.26 (25) $2.43 (26) $2.04 (28) $4.75 (29) $2.43 (49) $5.56 (278) $16. (281) $4.86 (288) $75.12 (293) $2.43 (294) $9.62	209 98
	$19,404 78
Add cost of valves sold for cash	7 99
29	$19,412 77

(3.)

Costs as reported in defendants' accounts, 3d period, May 1, 1881, to May 1, 1882	$39,173 68
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (36) $9. (39) $9.50 (40) $36. (41) $9.50 (45) $4.25 (46) $28.08 (48) $11.60 (50) $9. (53) $20. (54) $3.78 (57) $7.53 (58) $15. (59) $105.06 (60) $15. (63) $24.40 (65) $20. (68, 69) $15.10 (78) $2.34 (80) $26. (85) $1.89 (102) $9.50 (119) $5.24 (139) $15. (155) $6.50 (156) $9.50 (183) $18.80 (186) $40.60 (187) $37.64 (188) $18.90 (189) $5.80 (190) $29.75 (191) $7.53 (192) $81. (287) $2.90 (289) $36.60 (290) $12.20 (291) $15. (303) $2.90 (311) $4.86 (326) $12.20 (327) $13. (331) $4.25	762 70
	$38,410 98
Add cost of valves sold for cash	22 18
	$38,433 16

(4.)

Costs as reported in defendants' accounts, 4th period, May 1, 1882, to May 1, 1883	$31,653	59
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (74) $1.67 (83) $22.80 (86) $1.67 (88) $33.96 (93) $66.70 (94) $21.99 (95) $3.84 (96) $17.50 (97) $102. (98) $6.08 (100) $34. (105) $24. (109) $43.80 (111) $24. (112) $8.75 (115) $14. (120) $14. (123) $174.72 (124) $24. (134) $2.24 (135) $41.75 (136) $56. (142) $2.24 (158) $17. (168) $5.70. (170, 171) $41.74 (184) $6.56 (185) $42.24 (193) $52.50 (198, 199, 200) $65.64 (247) $17. (301) $5.70 (304) $2.65 (306) $6.68 (307) $22.64 (308) $28. (309) $150.30 (310) $92.75 (310*) $28.50 (313) $2.65 (314) $60. (316) $8.50 (319) $13.44 (320) $10.60 (321) $11.40 (322) $17. (323) $2.24 (328) $8.75 (329) $11.40	1,473	29
	$30,180	30
Add cost of valves sold for cash	34	70
	$30,215	00

30 (5.)

Costs as reported in defendants' accounts, 5th period, May 1, 1883, to Sept. 25, 1883	$12,532	22
Deduct on account of items numbered as in defendants' account of valves returned, etc., as follows: (132) $1.54 (133) $21.24 (137) $8. (138) $16.10 (146) $8.05 (147) $63.24 (149) $2. (153) $2.43 (157) $8. (159, 160, 161) $50.68 (162, 163) $95. (165) $8.05 (167) $35.75 (181, 182) $17.45 (220) $1.54 (255) $8. (324, 325) $18.59 (332) $8. (333) $2	375	66
	$12,156	56
Add cost of valves sold for cash	20	67
	$12,177	23
Add cost of one 1-inch valve sold J. H. Millett, not included in costs reported	1	54
	$12,178	77

* * * * * * *

31 *Master's Schedule C.*

Allowances to be made defendants for the period from Feb. 15, 1879, to Sept. 25, 1883, covered by the accounting in No. 1184.

Items are numbered as in defendants' account of valves returned, etc.

70.	May	3, 1879,	Portland Machine Works, failed,	$67 50
71.	May	10, 1879,	valve lost, cost	28 00
73.	Sept.	17, "	special services	32 50
172.	July	5, 1883,	uncollectible	7 50
173.	March	16, "	"	36 75
			also not entered in P. & L.	8 25
174.	Aug.	6, "	uncollectible	39 00
			also not entered in P. & L.	13 00
175.	July	26, 1882,	uncollectible	200 75
177.	Feb.	5, 1881,	"	25 00
178.	Sept.	11, 1880,	valve lost, cost	9 62
179.	"	26, "	" " "	26 30
180.	June	24, 1881,	uncollectible	7 50
194.	Aug.	26, 1881,	"	4 50
245.	June	30, 1883,	"	41 25
			also not entered in P. & L.	8 75
315.	March	8, 1883,	special expenses	9 61
			Total allowances for period from Feb. 15, 1879, to Sept. 28, 1883	$565 78

* * * * * * *

32 *Master's Schedule D.*

Summary showing profits of defendants from their valve business from Feb. 15, 1879, to Sept. 25, 1883.

Total sales (finding 1)		$215,641 23
Total costs (finding 2)	$115,244 22	
General expenses (finding 3)	50,734 55	
Allowances (finding 4)	565 78	
Cost of patterns (finding 5)	2,924 23	
Crosby's salary (finding 6)	2,309 20	
Boyden's salary, etc. (finding 6)	398 25	
Nickel-plating, etc. (finding 7)	565 01	
Interest (finding 10)	340 07	
Meady's patent lever (finding 11)	318 45	
Total costs and allowances		172,899 76
Total profits		$42,741 47

* * * * * * *

Aug. 15, 1888, I submitted the foregoing as a first draft report. Both parties filed objections to this draft—the complainants Aug. 30 and the defendants Nov. 13, 1888. I have carefully considered these objections, and have inserted in them notes showing my action thereon. I here annex these objections, with my notes, and follow them with master's corrected Schedules D and E, amended findings 13 and 14, referring to these schedules, and an amended general finding as to profits in cause No. 1184.

33 *Complainants' Objections to Master's First Draft Report and Requests for Findings.* (*Filed Aug.* 30, 1888.)

The complainants object to the master's report in the following particulars:

In this, that—

First. The master has made no finding upon that part of the fifth request for findings of fact which refers to the periodical stock accounts of the defendants and the prices of valves therein carried out, with comparisons between the returned costs, the lowest selling prices and the highest selling prices during the periods of accounting, which closed when the stock accounts were taken; which request is contained on the second page of the request for findings of fact, and the schedules are contained on the 3d, 4th, and 5th pages of the requests for findings of fact, and the fifth request is repeated.

(Master's note 1.—In making my first draft report, on page 3 I made the following statement:

"4. At the final argument before me counsel for both parties presented requests for findings, and I have these requests before me as I make my draft report."

I did not annex these requests to my draft report, because I did not deem it necessary to do so, as I had so framed my report, as I supposed, that my rulings upon such of the said requests as were material to the facts which I found (and which were all the facts which I deemed it necessary for me to find) were sufficiently stated in the text of said draft report. As complainants' objections to said draft report are based upon said requests for findings, I now annex said requests, and mark the same "Complainants' Requests for Findings, J. G. S., master."

In view of this first objection, I now state that, having found from the evidence before me "that defendants could not verify their calculations as to cost of valves by any contemporary memoranda," and having declined to adopt the method of stating the account proposed by complainants, namely, to take the lowest selling prices of defendants' valves for a given period of the accounting as the criterion of delivered costs, I do not deem it necessary to make any further finding in response to complainants' fifth request for findings.)

34 Second objection. The complainants object that no finding is made on the sixth request for findings of fact, contained on the 6th page of the requests for findings of fact, and ask the master to find as therain stated.

(Master's note 2.—In view of the manner in which I made up my draft report, I deem this objection immaterial and decline to make any further finding in response to complainants' sixth request for findings.)

Third objection. The complainants object to the ruling of the master that the defendants were entitled to sell any valves containing the improvement, which was the property of the complainants, in such a way as not to obtain a new dollar for an old one and then carry into account with the complainants the loss or debit complainants with such loss in any way.

They also object to the master's ruling that the defendants are entitled to have their entire valve business taken into consideration in estimating profits, whether each part of the valve business yielded a profit or not, and to ignore in this part of the account the individual valves.

Fourth objection. The complainants object to the method adopted by the master in making up the account, in which the individual valves are not itemized and taken into consideration, so that the valves sold at a loss may be separated from the valves sold at a profit, and request the master to report as to each and every specific valve concerning which the defendants filed a statement in voucher of their summary of account, whether it was sold at a profit or whether it was sold at a loss, and how much profit and how much loss accrued from each particular sale.

(Master's note 3.—These objections, third and fourth, apparently call for a separate finding as to the profit or the loss upon each valve made and sold by defendants. Such findings are unnecessary in view of the facts which I have stated in my draft report, namely, that the defendants carried on the manufacture and sale of valves as a continuous business; that the valves which they sold at a profit and those which they sold at a loss are intermingled, and that there is no considerable period during which they sold valves at a profit with no losses and no considerable period during which they sold valves continuously at a loss. I have made my findings upon the principle that the defendants are entitled to
35 have their entire valve business taken into consideration in estimating their profits from the infringement complained of.

It is not practicable upon the evidence before me to make a specific finding of profit or of loss as to each infringing valve made and sold by defendants, and it is unnecessary in this accounting, as reported in my draft report, to do so, even if it were practicable.)

Fifth objection. The complainants further object that the master has not found the average or particular cost price for each specific period of the accounting of each size and pattern of valve, as requested in the seventh request for findings of fact, on the sixth and following pages, and again request him to make the finding desired.

(Master's note 4.—I declined to adopt complainants' method of determining the costs to defendants of their valves as set forth in

Aug. 15, 1888, I submitted the foregoing as a first draft report. Both parties filed objections to this draft—the complainants Aug. 30 and the defendants Nov. 13, 1888. I have carefully considered these objections, and have inserted in them notes showing my action thereon. I here annex these objections, with my notes, and follow them with master's corrected Schedules D and E, amended findings 13 and 14, referring to these schedules, and an amended general finding as to profits in cause No. 1184.

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I did not annex these requests to my draft report, because I did not deem it necessary to do so, as I had so framed my report, as I supposed, that my rulings upon such of the said requests as were material to the facts which I found (and which were all the facts which I deemed it necessary for me to find) were sufficiently stated in the text of said draft report. As complainants' objections to said draft report are based upon said requests for findings, I now annex said requests, and mark the same "Complainants' Requests for Findings, J. G. S., master."

In view of this first objection, I now state that, having found from the evidence before me "that defendants could not verify their calculations as to cost of valves by any contemporary memoranda," and having declined to adopt the method of stating the account proposed by complainants, namely, to take the lowest selling prices of defendants' valves for a given period of the accounting as the criterion of delivered costs, I do not deem it necessary to make any further finding in response to complainants' fifth request for findings.)

34 Second objection. The complainants object that no finding is made on the sixth request for findings of fact, contained on the 6th page of the requests for findings of fact, and ask the master to find as therain stated.

(Master's note 2.—In view of the manner in which I made up my draft report, I deem this objection immaterial and decline to make any further finding in response to complainants' sixth request for findings.)

Third objection. The complainants object to the ruling of the master that the defendants were entitled to sell any valves containing the improvement, which was the property of the complainants, in such a way as not to obtain a new dollar for an old one and then carry into account with the complainants the loss or debit complainants with such loss in any way.

They also object to the master's ruling that the defendants are entitled to have their entire valve business taken into consideration in estimating profits, whether each part of the valve business yielded a profit or not, and to ignore in this part of the account the individual valves.

Fourth objection. The complainants object to the method adopted by the master in making up the account, in which the individual valves are not itemized and taken into consideration, so that the valves sold at a loss may be separated from the valves sold at a profit, and request the master to report as to each and every specific valve concerning which the defendants filed a statement in voucher of their summary of account, whether it was sold at a profit or whether it was sold at a loss, and how much profit and how much loss accrued from each particular sale.

(Master's note 3.—These objections, third and fourth, apparently call for a separate finding as to the profit or the loss upon each valve made and sold by defendants. Such findings are unnecessary in view of the facts which I have stated in my draft report, namely, that the defendants carried on the manufacture and sale of valves as a continuous business; that the valves which they sold at a profit and those which they sold at a loss are intermingled, and that there is no considerable period during which they sold valves at a profit with no losses and no considerable period during which they sold valves continuously at a loss. I have made my findings upon the principle that the defendants are entitled to have their entire valve business taken into consideration in estimating their profits from the infringement complained of.

It is not practicable upon the evidence before me to make a specific finding of profit or of loss as to each infringing valve made and sold by defendants, and it is unnecessary in this accounting, as reported in my draft report, to do so, even if it were practicable.)

Fifth objection. The complainants further object that the master has not found the average or particular cost price for each specific period of the accounting of each size and pattern of valve, as requested in the seventh request for findings of fact, on the sixth and following pages, and again request him to make the finding desired.

(Master's note 4.—I declined to adopt complainants' method of determining the costs to defendants of their valves as set forth in

complainants' seventh request for findings. I make no further finding in view of this fifth objection.)

Sixth objection. The complainants object to findings one and two of the master's report, contained on pages 6 and 7 of the report, that no classification, valve by valve, or size of valve by size of valve, is made in the schedule of sales or in the schedule of costs, and request this to be made.

(Master's note 5.—Such a classification as complainants request me to make would involve considerable labor, but would serve no useful purpose that I can conceive of, and I decline to make it.)

Seventh objection. The complainants object to the items contained in the master's Schedule C, in which valves sold but not paid for, uncollectible items and special services, are allowed to be deducted to the amount of $565.78. Uncollectible items of account should not form a credit in favor of a tort feasor in the account of the profit and loss of his tort, for it is a maxim of law that no man shall take advantage of his own wrong, and a maxim of morals that two wrongs do not make a right, and the first wrong in this case was using the complainants' patent property in the defendants' valve, and the second wrong was in selling the complainants' patent property, without the complainants' permission, to a bad debtor. It is difficult to understand on what principle of law or of ethics the owner of the property should be deprived of profits earned by the property from good sales which were paid for because of the bad judg-
36 ment of the tort feasor in conducting the business of his trespass, and the complainants further object to the item contained in the account in the master's Schedule D, finding 5, and to finding 5, on page 8 of the report, to the allowance of the cost of patterns, as the court, in these cases, has refused to order the patterns made by the defendants for the manufacture of these infringing valves to be destroyed or given up to the complainants. The master now finds that the complainants shall pay for them. Why they should be asked to pay the whole price for a thing which they they did not order made, which was made entirely for the convenience of the defendants in working an injury to complainants, and which, when the defendants were found to have wrongfully made, was not permitted to go into the possession of the complainants, the master may be able to find some legal rule for covering the case, but it would be difficult for any one else to understand. The situation seems to be this: The defendants made, without the wish and against the will of the complainants, certain things, used them for the complainants' injury until they were forbidden to do so any more; were then allowed by the court to keep them and deal with them as they chose and as of their own property, and now the master finds that these goods so made, so kept, and still in the possession and use of the defendants are to be paid for in full by the complainants. This is worse than the old case of deodands in indictments for murder, which were succinctly described by an ancient lay lawyer as a system adopted for hanging a man and fining him forty shillings thereafter.

Eighth objection. The complainants object to the finding of the

master on page 12, in which he declares that he has no evidence from which to report what portion of the profits, if any, are attributable to the Richardson invention of 1869, after the expiration of the Richardson patent of 1866.

(Master's note 6.—I make no change in my draft report in view of complainants' seventh and eighth objections.)

* * * * * * *

37 CONSOLIDATED SAFETY VALVE CO.,
By THOS. WM. CLARKE, *Solicitor.*

Defendants' Objections to Master's First Draft Report. (*Filed Nov.* 13, 1888.)

The defendants herewith submit their objections to the master's draft report, which are as follows, namely:

Finding 3. The objection of the defendants lies to the
38 method of the master in ascertaining the percentages from which the general expenses are computed applicable to valves. It is observed that in finding the net valve sales there are certain sums representing valves returned and certain discounts from the price of the valves sold, which are deducted from the valve sales reported by the defendants.

The percentages for distributing the general expense to the valve business are found by obtaining the ratio of the value sales as found by the master to the total sales of all products for like periods as furnished by the defendants. The total sales as well as the valve sales, as reported by the defendants in their accounts, embraced these valves returned and discounts. They formed part of both. In other words, the amount of valves returned and discounts treated by the master and taken by him from valve sales was a component part of the amount of valve sales as well as the total sales, the total sales being the sales of valves and of the other products of the defendants.

Now to obtain a proper and just ratio between the total sales and the valve sales, whatever is deducted from one must also be deducted from the other, if it is a common component part. In this view the defendants respectfully represent to the master that in finding 3 the percentages are incorrect to the extent that they represent the ratio of valve sales reduced as in findings 1 and 2 to the total sales, as reported by the defendants, which included the sums deducted by the master from the valve sales. They therefore respectfully ask that the master make the percentages represent the ratios of the valve sales, as determined in findings 1 and 2, to the total sales of products, diminished by the amounts deducted from the valve sales—that is, to eliminate from each the amounts common to both.

The defendants respectfully submit the following statement showing the percentages of valve sales to total sales, when both amounts have been reduced by items common to both.

Also the amounts of the general expenses applicable to valve sales computed upon such percentages.

39

	Valve sales, master's Schedule A.	Total sales reduced by amount deducted from valve sales.	Ratio or percentage.
From Feb. 15, 1879, to May 1, 1880	$29,749 53	$88,458 50 605 62	
		$87,852 88	33.86
From May 1, 1880, to May 1, 1881	37,110 12	101,087 62 639 73	
		100,447 89	36.94
From May 1, 1881, to May 1, 1882	65,436 65	157,078 27 1,626 45	
		155,451 82	42.09
From May 1, 1882, to May 1, 1883	58,573 48	176,997 11 3,262 70	
		173,734 41	33.71
From May 1, 1883, to Sept. 25, 1883	24,781 45	70,288 61 973 55	
		69,315 06	35.75
From Sept. 25, 1883, to May 1, 1884	28,703 95	107,667 71 984 55	
		106,683 16	26.90
From May 1, 1884, to Jan. 31, 1885	27,079 90	99,314 65 544 05	
		98,770 60	27.41

40 *Amounts of General Expenses Chargeable to Valve Business.*

1st period,	33.86 %	of $21,626.75,	or	$7,322 82
2d "	36.94 %	" 27,605.39,	"	10,197 43
3d "	42.09 %	" 30,059.22,	"	12,651 93
4th "	33.71 %	" 43,029.63,	"	14,505 29
5th "	35.75 %	" 18,622.69,	"	6,657 61
6th "	26.90 %	" 28,341.54,	"	7,623 87
7th "	27.41 %	" 32,579.21,	"	8,929 96

Total general expenses to valves, Feb. 15, 1879, to Sept. 25, 1883, were ---- 51,335 08

Total general expenses to valves, Feb. 15, 1879, to Jan. 31, 1885, were ---- 67,888 91

(Master's note 26.—This objection is well taken. I have verified defendants' calculations and find them correct. I annex schedules entitled "Master's Corrected Schedule D" and "Master's Corrected Schedule E," in which I have put the general expenses chargeable to the valve business as the defendants have calculated them in the above objection.)

Finding 6. The objection made by the defendants lies in the computation made by the master. The defendants say that the amount to be allowed should be ascertained from the same percentages as the amounts of the general expenses applicable to safety-valves.

These percentages have already been expressed in defendants' objections to finding 3 of the master. The amount of Crosby's salary as by such percentages is, for the periods embraced in suit No. 1184, $2,330.09; in suit No. 1199, $2,879.42.

The amount of Boyden's salary and expenses for the same periods is, in suit No. 1184, $382.03; in suit No. 1199, $485.06.

(Master's note 27.—This objection is also well taken. In my corrected Schedules D and E, I have inserted as allowances to defendants for the one-half of Crosby's salary and the one-half of Boyden's salary and expenses claimed in item 2 the sums which the defendants say in this objection I should allow.)

41 Finding 7. The attention of the master is called to an error in stating the amounts of items 3, 4, 5, and 6, as in each suit the lock-up attachments, which are a part of item 6, are omitted, being in 1184 $163.68 and in 1199 $287.69, making the total in No. 1184 $728.69 and in No. 1199 $1,422.61, instead of those given.

(Master's note 28.—This objection is also well taken, and I make corrections accordingly, which appear in and by my corrected Schedules D and E.)

Finding 8. The charge found in item 7, in heading IV of defendants' account filed with the master, is for the reconstruction and modification of safety-valves made by them. The work of this modification and reconstruction was in the direction of perfecting the characteristics of the safety-valves they were then producing. The result of such endeavor was that they produced a species of safety-valves, classified in the account as iron safety-valves, which was made and sold after that time by the defendants, the account of which has been fully rendered to the master, and on which he has computed profits in his consideration of them.

In the labor and efforts of the defendants certain valves were rendered useless and were valueless except for junk, and certain parts of valves made for them and paid for were rejected, and the difference between the original cost and their value as old metal became a loss to the defendants. All these losses occasioned by the destruction of valves, by the replacing of valves in hands of buyers of valves by giving them new valves for old ones without additional charge, and by the destruction of parts of valves which could not be used because of the modification of the design were a part of the expense suffered by the defendants in their valve business in the producing and manufacture of a marketable safety-valve of the characteristics of the Crosby valve, and constituted a wastage in

their business which their valve department suffered for the purpose of making more salable products. This loss was an item of expense which should be charged to the cost of valves as such, because it became a charge upon all the safety-valves thereafter made following the plan and models which resulted from such loss.

Upon inspection of the records of the master the defendants do not find that they have filed specifications of such loss, and,
42 trusting to the belief that their account, with the testimony, was sufficient and proper in such respect, they evidently neglected so to do. Moreover, the examination of Mr. Crosby, the defendants' superintendent at that time, by the complainants upon that item of their account shows only the items of loss in part.

This latter incomplete showing, which is now first noticed by the defendants, was evidently overlooked, and thus the facts making up the character of the loss were not properly and fully laid before the master for his consideration. On this account the defendants respectfully submit a statement of facts, and request that they may introduce testimony, if necessary, in proof thereof.

Statement.

In the winter of 1882 and spring of 1883 certain important and valuable improvements were incorporated into the iron safety-valves made by the defendants, requiring a radical and complete modification of their form and structure.

On this account there were returned to the defendants by Messrs. Babcock & Wilcox, of New York, 38 safety-valves and new ones sent to them in their stead, for which no charge was made. They were as follows, namely:

4 2½" iron safety-valves.
11 3" " " "
13 3½" " " "
10 4" " " "

These valves were destroyed as not salable after the new pattern was determined upon.

In addition to these there were also destroyed, as being of the same design and pattern, the following:

19 2½" iron safety-valves.
16 3" " " "
19 3½" " " "
15 4" " " "

together with twelve brass valves of various sizes, all of the above being mentioned by Mr. Crosby in his testimony, Record, page 346.

Those originally sold to Babcock & Wilcox were accounted for.
When they were returned new ones of the new design and
43 pattern replaced them without charge to Babcock & Wilcox by the defendants. No account of these latter valves was rendered in the defendants' account to the master. The brass valves referred to were accounted for, and items Nos. 191, 192, and 193 treat of them as returned. None of the others were accounted for, as none were consigned or sold. The loss to the company upon

these valves was shown by Mr. Crosby, Record, pages 345, 346, 347.

Besides the destruction of these complete valves there was a loss, by the sale of 19,017 pounds of iron castings, of $475.42, arising from a sale of them for one cent per pound after a cost to the defendants of three and one-half cents per pound.

All these losses grew directly from the perfecting of the defendants' safety-valve.

Whenever valves have been accounted for as returned and the master has deducted the returned valves from the sales and costs the account then shows itself free from any profits on such valves. The cost to the defendants of such valves remains as a part of the expenses they have incurred in the making of valves, and which, when they were destroyed, became a direct loss to them and their business. It is for this actual loss so sustained, decreasing their profits, which they now ask to have allowed. The loss is inseparable from their whole valve business and belongs to it.

(Master's note 29.—It is clear upon this statement that no allowance should be made to defendants for the sixty-nine valves which they made and destroyed without selling or consigning them. The thirty-eight valves which were originally sold to Babcock & Wilcox were accounted for both in costs and sales, but when new valves were sent them to replace the returned valves the new valves were not included in defendants' accounts, either in costs or sales. The twelve brass valves were returned and so treated in the account. The result, therefore, is substantially this, that the defendants made some one hundred and nineteen valves which they subsequently destroyed, with some castings which they concluded not to use. I find no sufficient reasons for modifying my former disallowance of item 7 in each case.)

Finding 9. Under the permission granted by the master to the defendants to file with him such explanations as they may be advised as proper to sustain their claim for certain commissions as follows:

	Item 169, Ripley & Kimball	$44 50
44	" 201, L. G. Tillotson & Co.	388 00
	" 258, " "	90 00
Item	272, Frick & Co., advertising	35 00
"	282 to 286, W. Dixie	774 70

(Item 258 was evidently overlooked by the master and is here introduced. It is found in the defendants' account as filed.)

The defendants herewith submit the following statement:

Prior to 1879 the defendants entered into an agreement with Messrs. L. G. Tillotson & Co., of New York city, under which they agreed to give them the exclusive right to sell their safety-valves in certain Southern States.

One of the provisions of the agreement was that whenever the defendants sold any of their safety-valves directly to a consumer residing in that territory carrying on the transaction independent of

the Messrs. Tillotson & Co. the defendants should pay to them a certain percentage of the net price at which the defendants sold and received for them.

This agreement continued in force during the time embraced in items 201 and 258. The commissions represented by said items 201 and 258 were paid to said Tillotson & Co. for sales of safety-valves made by the defendants directly to purchasers residing within the territory above mentioned during the time of the accounting in these cases. All the dealings as to these safety-valves were the defendants', of which the Messrs. Tillotson & Co. had nothing to do except the right to claim their commission under said agreement. And these commissions allowed were to compensate the Messrs. Tillotson & Co. for their work in the territory given them into which they were to introduce the safety-valves and from whose efforts these sales may have arisen.

These commissions constituted a specific charge upon the defendants' net receipts for the safety-valves which they sold. They have been accounted for at the prices at which they were sold. The defendants respectfully submit to the master a detailed statement showing each commission paid them. They are appended herewith and marked "Defendants' Tillotson & Co.'s Commissions No. 1184" and "Defendants' Tillotson & Co. Commissions No. 1199."

Second. The commissions paid W. Dixie were the only
45 compensation given him for his services and expenses in selling and introducing the safety-valves of the defendants, and whose sales have already been accounted for to the master.

Whenever he sold a safety-valve and reported it to the defendants his sale so made and reported was adopted by them, and thereafter they dealt directly with the purchaser.

Upon the collection of the price to be paid Mr. Dixie received his commission agreed upon.

The commissions represented by items 282 to 286 were those actually earned by him in the sale of safety-valves and paid to him by the defendants. They became a charge upon the net result of the sales of the safety-valves.

The defendants herewith submit a statement giving the details of the commissions so paid, and it is marked "Defendants' Dixie's Commissions No. 1184 and No. 1199."

(Master's Note 30.—I submitted the foregoing statement to complainants' counsel, Mr. Clarke, asking him to inform me if he would consent that the explanations of defendants may be taken as true, and, if so taken, if he objected to the allowance of the items claimed, and he replied as follows:

"I do not require any proof of the statements contained on the first and second pages of your letter as far as the words "sales may have arisen." The next paragraph, that the commissions constituted a specific charge on defendants' net receipts, constitutes a proposition of law which I do not agree to. They constituted, if allowed in the account, a specific charge against the specific valves for the sale of which the commissions were paid. If each of those valves yielded a profit after the Tillotson commission was paid, the Tillotson com-

mission for that valve belongs in the account; if the specific valve did not yield a profit after the Tillotson commission was paid, that specific valve does not belong in the account, and the Tillotson commission on it does not belong in the account. The same rule applies to the Dixie commissions, which are to be taken into consideration only with regard to the valves to which they apply, not with regard to the general account."

Mr. Clarke thus emphasizes his contention that each valve is to be accounted for as to profits separately, but does not require proof that these commissions were paid to Tillotson & Co. and to W. Dixie, as stated by defendants. I allow as a charge against the profits of the defendants from their safety-valve business, as shown by the detailed statements submitted by them:

46	Commissions paid Tillotson & Co. prior to Sept. 25, 1883	$373 00
	Commissions paid W. Dixie prior to Sept. 25, 1883	765 00
	Total in No. 1184	$1,138 00
	Additional commissions paid Tillotson & Co. after Sept. 25, 1883	90 00
	Total in No. 1199	$1,228 00)

Third. Item 169 refers to an allowance which the defendants made to Messrs. Ripley & Kimball, due to an error or misunderstanding in the prices charged for certain safety-valves they bought, to wit:

An increase of discount to make the total discount on the valves bought equal to 75% of the list price	$44 50

(Master's note 31.—This explanation is not sufficiently full. "Certain safety-valves" is too indefinite. I cannot verify the amount claimed unless an account of discounts is stated and the list prices of the valves are given. I disallow this item.)

Fourth. Item 272. Messrs. Frick & Co. were purchasers of safety-valves only, and the sums paid them as represented by said item was for an advertisement of the defendants' products, published by them in some catalogue or periodical issued by them. Upon a careful examination of the matter there is some doubt about its allowance by the master in this place.

(Master's note 32.—I disallow this item.)

Fifth. Item 196 relates to the Dickson Manufacturing Company. This deduction is asked because, in making up the account, the clerk entered into it two safety-valves received by them, when, in fact, the only things they received were two cylinders or outside shells or covers for two safety-valves they had. They were only parts of the structure, and ought not to have been accounted for at all. This item should be deducted to relieve the account of them.

(Master's note 33.—This does not appear to me to be an explana-

tion of item 196, which is a claim for an allowance on one 2½-inch valve returned. The two 2½-inch shells appear in the accounts as a different item. I now finally dispose of this claim by dis-
47 allowing it, the evidence relating thereto not being sufficient to sustain it.)

Finding 11. The attention of the master is respectfully called to the omission of the amount due to Meady's patent lever in No. 1199, being $842.40.

(Master's note 34.—Upon the pleadings and evidence before me, I make the allowance, as claimed by defendants in No. 1199, of $842.40, due to Meady's patent lever, and insert it in my corrected Schedule E.).

Findings 13 and 14. Findings 13 and 14 relate to suits No. 1184 and No. 1199, and are objected to by the defendants as incorrect in showing the profits made by the defendants during the periods embraced in those suits. They should be modified to be as follows, namely:

No. 1184, $38,251.55;

No. 1199, $46,793.07;

and the reasons for the modifications are given in the objections already noted.

(Master's note 35.—Findings 13 and 14 should be modified by substituting in finding 13, for $42,741.47, the total profits shown by master's corrected Schedule D, namely, $40,344.59, and by substituting in finding 14, for $51,953.08, the total profits shown by master's corrected Schedule E, namely, $48,886.11.)

The defendants respectfully say that the amounts stated are evidently incorrect, aside from the claims made by their objections due from certain omissions herein noted in finding 7 for No. 1184, and in findings 7 and 11 for No. 1199; and an incorrect addition in master's Schedules D and E.

SCHEDULE D.

Finding 1.	Total sales			$215,641 23
" 2.	Total costs	$115,244 22		
" 3 (obj.)	General expenses	51,335 08		
" 4.	Allowances	565 78		
" 5.	Cost of patterns	2,924 23		
" 6 (obj.)	Crosby's salary	2,330 09		
" 6 (obj.)	Boyden's salary, etc.	382 03		
Finding 7.	Nickel-plating	728 69		
48 Finding 8 (obj.)	Modification, etc., valves	1,978 84		
Finding 9 (obj.)	Commissions, etc.	1,242 20		
" 10.	Interest	340 07		
" 11.	Meady lever	318 45		
			177,389 68	
				$38,251 55

* * * * * * *

(Master's note 36.—Master's corrected Schedule D and master's corrected Schedule E show how I make up the profits which the defendants derived from their valve business during the periods covered by these accountings after I have carefully considered the objections of both parties to my first draft report.)

The defendants respectfully submit their objection to the master's finding that the complainants' valves of commerce contained the invention of Richardson, in view of the decision of the Supreme Court defining that invention and the evidence introduced before him, comparing the construction of the said valves with such
49 definition, and they refer the master to the uncontradicted testimony as follows:

Richardson, Record, pages 438–442; Harrison, pages 456–468; Burnett, 488–496; Renwick, pages 508–510.

(Master's note 37.—I reaffirm the statement contained in my first draft report that "upon the whole evidence, with specimens of all the different valves put upon the market by the complainants before me, I find that they all contain Richardson's improvement of 1866.")

Finding 15. The objection of the defendants to this finding rests upon the following grounds:

1. Because the master, having determined that the defendants had derived certain profits from the manufacture of their Crosby valves, assigned all these profits to the complainants upon the reason that "the entire commercial value of the valves manufactured and sold by the defendants" is due "to the improvement covered by Richardson's patent of 1866," without which "the Crosby form is worthless;" while he ought to have found upon the evidence that, with the exception of an allowance of a nominal sum for profits on account of the Richardson invention, these profits accrued to the defendants from their employment of the Crosby inventions and improvements, and moreover that the Richardson improvement of the patent of 1866 was not of any commercial value when appropriated in a safety-value on account of its wastefulness. Herein the defendants respectfully refer to the testimony of F. T. Simmons, particularly pages 389–391, 398–400, of the Record; John C. Hoadley, pages 426–430; Harrison, pages 446–448; Burnett, pages 492–496, and Ints. 31 to 36, inclusive; Renwick, pages 508–510, inclusive; Crosby, Ints. 23 and 24, page 511.

2. Because the master refused to find that the complainants were bound to submit evidence before him showing or tending to show the value of the Richardson invention, as set forth in the patent of 1866 and construed by the Supreme Court, over and above the value of the Webster and other steam-valves previously known to the art, and because the master in so refusing has stated the account of profits due from the defendants to the complainants on an incorrect basis by finding that the complainants were entitled to the
50 entire profits realized by the defendants for the sale of valves during the period covered by the accounting.

3. Because, there having been no evidence submitted by the complainants before the master to show the value of the Richardson

invention in comparison with what was previously known in the art, which prior art was submitted in proof by the defendants to the master, the master found that all the profits which had accrued to the defendants from the sale of valves were payable to the complainants.

(Master's note 38.—I have clearly set forth my views as to the value of the Richardson invention of 1866 in two paragraphs of my first draft report, commencing near the bottom of page 10, and I make no change in these paragraphs upon consideration of the grounds above stated, numbered 1, 2, and 3.)

4. Because the master assigned all the defendants' profits as found by him to the complainants contrary to the pleadings in the suit, which limited the master to the sum of $20,000, which could be assigned by him upon any ground of recovery found by him favorable to the complainants.

(Master's note 39.—I do not so understand the pleadings. As I read them, the limitation referred to relates to the damages in excess of profits and not to profits.)

The defendants respectfully request the master to append to his report the testimony of F. T. Simmons, Ints. 28 to 42, inclusive, Ints. 61 to 70, inclusive; John C. Hoadley entire; William H. Harrison, Ints. 1 to 48, inclusive; William Burnett, Ints. 1 to 38, inclusive; Henry B. Renwick, entire, and George H. Crosby, Ints. 13, 23, and 24, pages 376, 511, and 512 of the Record, and to submit with his report the exhibits referred to in the said testimony and introduced by the defendants in the proceedings before the master.

(Master's note 40.—I reserve my decision upon this request till I have submitted a second draft report and given the complainants an opportunity to say what, if any, of the evidence before me they wish reported.)

B. F. THURSTON,
J. H. MILLETT,
Counsel for Defendants.

51 *Master's Corrected Schedule D.*

Summary showing profits of defendants from their valve business from Feb. 15, 1879, to Sept. 25, 1883.

Total sales (finding 1, page 7)		$215,651 23
Total costs (finding 2, page 7)	$115,244 22	
General expenses (master's note 26, page 41)	51,335 08	
Allowances (finding 4, page 8)	565 78	
Costs of patterns (finding 5, page 8)	2,924 23	
Crosby's salary (master's note 27, page 41)	2,330 09	
Boyden's salary (master's note 27, page 41)	382 03	
Nickel-plating, etc. (finding 7, page 9, modified by master's note 28, page 42)	728 69	
Commissions (master's note 30, page 46)	1,138 00	

Interest (finding 10, page 10)	340 07	
Meady's patent lever (finding 11, page 10)	318 45	
		175,306 64
Total profits in No. 1184		$40,344 59

* * * * * * *

52 Amended finding 13.

The total profits which the defendants derived from their manufacture and sale of steam safety-valves containing the improvement described and claimed in letters patent No. 58294, to Richardson (being patent declared on in No. 1184), from Feb. 15, 1879, to Sept. 25, 1883, as shown by master's corrected Schedule D, amount to $40,344.59.

Amended finding 14.

The total profits which the defendants derived from their manufacture and sale of steam safety-valves containing the improvement described and claimed in letters patent No. 85693, to Richardson (being the patent declared on in No. 1199), from Feb. 15, 1879, to Jan. 31, 1885, as shown by master's corrected Schedule E, amount to $48,886.11.

Amended General Finding as to Profits in Cause No. 1184.

Amended finding 15.

I find that the complainants are entitled to recover of the defendants forty thousand three hundred and forty-four dollars and fifty-nine cents ($40,344.59) as and for the profits received by the defendants from their infringement of letters patent No. 58294 (being the patent declared on in No. 1184) from Feb. 15, 1879, to Sept. 25, 1883.

Master's corrected Schedule E shows the profits which the defendants made from their valve business from Feb. 15, 1879,
53 to Jan. 31, 1885, to be $48,886.11; but I am unable to determine from the evidence before me what portion of these profits, if any, is attributable to the Richardson invention of 1869, declared on in the second case before me, No. 1199.

I make no change in my general findings 16 and 17, on page 15.

Respectfully submitted.

JOHN G. STETSON, *Master.*

March 9, 1889, I submitted the foregoing as a second draft report. Both parties filed objections to this draft—the defendants March 18, and the complainants April 1, 1889. I have carefully considered these objections and have inserted in them notes showing my action thereon.

Complainants' Objections to Master's Second Draft Report and Requests for Findings. (*Filed April* 1, 1889.)

On the submission of the second draft report the complainants make the following objections thereto:

Twelfth objection. That the situation before the master was, the complainants suggested a way of stating the account, the master refused to follow the complainants' suggestions, but stated the account in a different way, in which he took from the defendants' returns, as and for the manufacturing costs of the valves produced by them, certain manufacturing costs returned by them for the respective sizes of valves produced in the different periods of the accounting; he took from the sales account of the defendants the number of valves which they reported as sold according to the sizes which they reported; he multiplied the price of valves for each size in each period by the number of valves of the same size reported sold for that period, and thus ascertained what he called the costs; he then took the prices charged on the sales account for the valves reported sold as the receipts of the business; he then ascertained by similar methods the cost of the valves reported sold which were returned and deducted that amount from the amount of costs for the period, also deducting the amount charged for the valves on the sales
54 account from the receipts. He then ascertained the whole amount of general expenses for each of the periods of the accounting, and took a percentage of this, which represented the percentage which the sale of valves bore to the sales of all defendants' products, as the percentage of general expenses properly chargeable to valves for the period. He then took various charges which the defendants claimed, and made with them and with the general expenses a general allowance for two groups of periods, one including the accounting of case No. 1184, and the other including the accounting in case No. 1199, and with these as factors produced the result which he did produce.

The complainants' contention being that the master's way of stating the account was not a proper way of stating it, and the defendants having produced before the master certain evidence showing that at various times in the course of the period accounted for they had taken sundry accounts of stock in which the valves on hand were charged at certain prices which varied from the cost prices taken by the master, the master has refused to find that these contemporary memoranda of costs and values of valves on hand at the end of either or any of the periods of the accounting are relevant facts upon any of the contentions before the master. Complainants therefore ask the master to report the evidence contained in Ints. 137 to 155 of the examination of George H. Eager, on pages 320 to 322 of the proceedings before the master, and the answers thereto, and Int. and Ans. 158 of the same examination, on page 323, and the schedule marked "Exhibit Valve Stock in Hand, J. G. S., master."

(Master's note 41.—In my first draft report, pages 2 to 7, I stated the course of the proceedings before me and the method by which

I find the amount of the total sales and the amount of the total costs of defendants' valves for the periods covered by the accountings in these cases. In a paragraph near the middle of page 6 I indicated why I find the costs of the valves for the several periods to be correctly given by the defendants in their accounts. I did not intend by master's note 1 to rule that Exhibit Valve Stock in Hand and the testimony of Mr. Eager relating thereto are not relevant evidence upon the question of the costs of defendants' valves. I find the costs upon the whole evidence, as I stated on page 6, and Exhibit Valve Stock in Hand and Mr. Eager's testimony relating thereto, though admissible upon the question of costs, are not conclusive, but must be weighed with the other evidence before me.

55 I will report the evidence asked for in this objection. See master's note 96.)

Thirteenth objection. That the master has refused to make the classification requested by the sixth objection for the reasons there stated, and has thereby refused to state as facts the basis on which the master made his calculations and to state what items went into the sales account and what items went into the cost account, as distinguished from loadings and allowances.

(Master's note 42.—I have stated the basis on which I made my calculations in making up the accounts in these cases, and have clearly indicated all the items which went into the accounts. What I refused to do by master's note 5 upon complainants' sixth objection was to make a classification, valve by valve or size of valve by size of valve, in schedules of sales and of costs. I did not make up the accounts upon the basis of individual sales, estimating the profit or the loss upon the sale of each valve. I found that the defendants had carried on the manufacture and sale of valves as a continuous business. I found that they had stated in the accounts which they filed the costs of their valves, size by size, for periods covering the whole time of the accounting, and that they had stated their sales in like manner. I found upon the evidence before me that defendants had correctly stated in their accounts the costs of their valves and their receipts from sales, except that they had included in each the costs of and receipts from certain valves which should not have been included therein. I found that the accounts were correctly made up by the defendants on principle, and that I could correct the errors therein from the evidence before me, and I made the corrections. Having found the amounts received by the defendants from sales, I deducted therefrom the costs, including proper allowances, and so found the profits for each period. Each allowance which I made I clearly described. All my calculations can be easily verified. If I have erred it must be in the principle I have adopted, namely, that the defendants are required to account for the profits which they have received from their continuous business, and not for profits from individual sales to be considered separately from the sales which they made at a loss in the progress of their business during the periods of these accountings.)

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54 account from the receipts. He then ascertained the whole amount of general expenses for each of the periods of the accounting, and took a percentage of this, which represented the percentage which the sale of valves bore to the sales of all defendants' products, as the percentage of general expenses properly chargeable to valves for the period. He then took various charges which the defendants claimed, and made with them and with the general expenses a general allowance for two groups of periods, one including the accounting of case No. 1184, and the other including the accounting in case No. 1199, and with these as factors produced the result which he did produce.

The complainants' contention being that the master's way of stating the account was not a proper way of stating it, and the defendants having produced before the master certain evidence showing that at various times in the course of the period accounted for they had taken sundry accounts of stock in which the valves on hand were charged at certain prices which varied from the cost prices taken by the master, the master has refused to find that these contemporary memoranda of costs and values of valves on hand at the end of either or any of the periods of the accounting are relevant facts upon any of the contentions before the master. Complainants therefore ask the master to report the evidence contained in Ints. 137 to 155 of the examination of George H. Eager, on pages 320 to 322 of the proceedings before the master, and the answers thereto, and Int. and Ans. 158 of the same examination, on page 323, and the schedule marked "Exhibit Valve Stock in Hand, J. G. S., master."

(Master's note 41.—In my first draft report, pages 2 to 7, I stated the course of the proceedings before me and the method by which

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Thirteenth objection. That the master has refused to make the classification requested by the sixth objection for the reasons there stated, and has thereby refused to state as facts the basis on which the master made his calculations and to state what items went into the sales account and what items went into the cost account, as distinguished from loadings and allowances.

(Master's note 42.—I have stated the basis on which I made my calculations in making up the accounts in these cases, and have clearly indicated all the items which went into the accounts. What I refused to do by master's note 5 upon complainants' sixth objection was to make a classification, valve by valve or size of valve by size of valve, in schedules of sales and of costs. I did not make up the accounts upon the basis of individual sales, estimating the profit or the loss upon the sale of each valve. I found that the defendants had carried on the manufacture and sale of valves as a continuous business. I found that they had stated in the accounts which they filed the costs of their valves, size by size, for periods covering the whole time of the accounting, and that they had stated their sales in like manner. I found upon the evidence before me that defendants had correctly stated in their accounts the costs of their valves and their receipts from sales, except that they had included in each the costs of and receipts from certain valves which should not have been included therein. I found that the accounts were correctly made up by the defendants on principle, and that I could correct the errors therein from the evidence before me, and I made the corrections. Having found the amounts received by the defendants from sales, I deducted therefrom the costs, including proper allowances, and so found the profits for each period. Each allowance which I made I clearly described. All my calculations can be easily verified. If I have erred it must be in the principle I have adopted, namely, that the defendants are required to account for the profits which they have received from their continuous business, and not for profits from individual sales to be considered separately from the sales which they made at a loss in the progress of their business during the periods of these accountings.)

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Twelfth objection. That the situation before the master was, the complainants suggested a way of stating the account, the master refused to follow the complainants' suggestions, but stated the account in a different way, in which he took from the defendants' returns, as and for the manufacturing costs of the valves produced by them, certain manufacturing costs returned by them for the respective sizes of valves produced in the different periods of the accounting; he took from the sales account of the defendants the number of valves which they reported as sold according to the sizes which they reported; he multiplied the price of valves for each size in each period by the number of valves of the same size reported sold for that period, and thus ascertained what he called the costs; he then took the prices charged on the sales account for the valves reported sold as the receipts of the business; he then ascertained by similar methods the cost of the valves reported sold which were returned and deducted that amount from the amount of costs for the period, also deducting the amount charged for the valves on the sales
54 account from the receipts. He then ascertained the whole amount of general expenses for each of the periods of the accounting, and took a percentage of this, which represented the percentage which the sale of valves bore to the sales of all defendants' products, as the percentage of general expenses properly chargeable to valves for the period. He then took various charges which the defendants claimed, and made with them and with the general expenses a general allowance for two groups of periods, one including the accounting of case No. 1184, and the other including the accounting in case No. 1199, and with these as factors produced the result which he did produce.

The complainants' contention being that the master's way of stating the account was not a proper way of stating it, and the defendants having produced before the master certain evidence showing that at various times in the course of the period accounted for they had taken sundry accounts of stock in which the valves on hand were charged at certain prices which varied from the cost prices taken by the master, the master has refused to find that these contemporary memoranda of costs and values of valves on hand at the end of either or any of the periods of the accounting are relevant facts upon any of the contentions before the master. Complainants therefore ask the master to report the evidence contained in Ints. 137 to 155 of the examination of George H. Eager, on pages 320 to 322 of the proceedings before the master, and the answers thereto, and Int. and Ans. 158 of the same examination, on page 323, and the schedule marked "Exhibit Valve Stock in Hand, J. G. S., master."

(Master's note 41.—In my first draft report, pages 2 to 7, I stated the course of the proceedings before me and the method by which

I find the amount of the total sales and the amount of the total costs of defendants' valves for the periods covered by the accountings in these cases. In a paragraph near the middle of page 6 I indicated why I find the costs of the valves for the several periods to be correctly given by the defendants in their accounts. I did not intend by master's note 1 to rule that Exhibit Valve Stock in Hand and the testimony of Mr. Eager relating thereto are not relevant evidence upon the question of the costs of defendants' valves. I find the costs upon the whole evidence, as I stated on page 6, and Exhibit Valve Stock in Hand and Mr. Eager's testimony relating thereto, though admissible upon the question of costs, are not conclusive, but must be weighed with the other evidence before me.

55 I will report the evidence asked for in this objection. See master's note 96.)

Thirteenth objection. That the master has refused to make the classification requested by the sixth objection for the reasons there stated, and has thereby refused to state as facts the basis on which the master made his calculations and to state what items went into the sales account and what items went into the cost account, as distinguished from loadings and allowances.

(Master's note 42.—I have stated the basis on which I made my calculations in making up the accounts in these cases, and have clearly indicated all the items which went into the accounts. What I refused to do by master's note 5 upon complainants' sixth objection was to make a classification, valve by valve or size of valve by size of valve, in schedules of sales and of costs. I did not make up the accounts upon the basis of individual sales, estimating the profit or the loss upon the sale of each valve. I found that the defendants had carried on the manufacture and sale of valves as a continuous business. I found that they had stated in the accounts which they filed the costs of their valves, size by size, for periods covering the whole time of the accounting, and that they had stated their sales in like manner. I found upon the evidence before me that defendants had correctly stated in their accounts the costs of their valves and their receipts from sales, except that they had included in each the costs of and receipts from certain valves which should not have been included therein. I found that the accounts were correctly made up by the defendants on principle, and that I could correct the errors therein from the evidence before me, and I made the corrections. Having found the amounts received by the defendants from sales, I deducted therefrom the costs, including proper allowances, and so found the profits for each period. Each allowance which I made I clearly described. All my calculations can be easily verified. If I have erred it must be in the principle I have adopted, namely, that the defendants are required to account for the profits which they have received from their continuous business, and not for profits from individual sales to be considered separately from the sales which they made at a loss in the progress of their business during the periods of these accountings.)

* * * * * * *

56 Twenty-third objection. Complainants object to the finding of the master that commissions paid for the sale of specific valves are not to be carried in account as a specific charge on the valves, but are properly to be sprinkled round on a general account and applied to the receipts for valves on which the commission was not allowed.

Twenty-fourth objection. Complainants object to the allowances made to the Meady patent lever, and as there made as a general charge instead of a charge against specific valves.

Twenty-fifth objection. Complainants also object to each and every allowance made by the master for bad debts and uncollectible items, as they introduce into the account of profits a deduction for specific losses which the master was not directed to state, and because, also, they leave in the account a charge for specific
57 costs against which no receipts were had by the defendants, and thereby make a charge to the complainants arising from the defendants' defective way of transacting business, which makes a part of the business costly to them beyond the receipts therefor.

Twenty-sixth objection. Complainants object to the allowance of the Tillotson and Dixie commissions, because they are not distributed specifically to the periods of the accounting.

(Master's note 51.—Complainants' 23d, 24th, 25th, and 26th objections, if I understand them, are a renewal of the demand that the accountings for profits in these cases should deal with individual valves; that the cost of each valve should be determined and, if in any instance the cost of a valve exceeds the sum which was actually received for it, such valve should be eliminated from the accounts. I decline to adopt this view upon the evidence before me, as I find that the defendants carried on a continuous business in making and selling valves, and that they should account to the complainants for the profits they have received during the periods covered by the accountings respectively, which profits are to be determined by deducting from their gross receipts from sales the total costs of their valves, including proper allowances for general expenses and for losses from uncollectible debts.)

Twenty-seventh objection. Complainants object to the citation of the evidence of Francis T. Simmons, a witness for the defendants, and contained on pages 30 and 31, without the citation of a cross-examination of said Simmons upon the same subject-matter, and ask to have reported the cross-examination of said Simmons, beginning at cross-int. 71 and continuing to cross-int. 137.

(Master's note 52.—This objection is satisfied by my action in reporting the evidence before me, as stated in master's note 98.)

And the complainants make the following requests for findings of fact:

Twenty-second request for findings of fact. That in and by the text of the assignment of the Richardson letters patent in suit, printed on page 45 in the record of this court, not only were the patents assigned to these complainants, but also the inventions secured or to be secured by said patents, and all reissues, extensions,

and renewals of the same or either of them which may be hereafter granted, meaning and intending to convey the right to de-
58 mand, collect, and receive any and all sums of money which are now due to them or said firm of George W. Richardson & Co. for royalties, patent fees, and infringements of said patents or either of them, hereby authorizing said grantee to take all necessary and proper steps, by suits or otherwise, to collect, receive, or enjoy all that may be due from users or infringers of said patents or either of them.

(Master's note 53.—The assignment of the Richardson letters patent referred to is a part of the record in this case. It is not necessary that I should make any finding as to its contents.)

Twenty-third request for findings of fact. That the master, in making up the account as stated by him, arrived at the amount of sales by adding together the sums received for individual valves or for lots of valves sold to the same customer, which valves or lots of valves were sold at stated prices each or by the lots as delivered. In making up the costs, he assumed from the defendants' testimony and return a certain price in each period as the uniform shop cost of a given size of valve, and multiplied this price returned by defendants for each several size in each period by the number of valves of that respective size sold during the same period, and thus ascertained the cost of all the valves of each size during each period, and, by adding together the amounts, obtained the item which he has stated in finding 2, on page 52, total costs.

(Master's note 54.—The statements made in this request are theoretically correct, though the actual methods employed by the master in arriving at total sales and total costs are shown by findings 1 and 2 (pages 6 and 7) in connection with Schedule A (sales) and Schedule B (costs) (pages 15 to 22). The methods described in this request would produce the same results.)

Twenty-fourth request for findings of fact. That the master in making the finding 1 of Schedule D, on page 52, total sales, made it up by arithmetical processes which took into consideration and were based upon the moneys received for individual valves or separate lots of valves; and in making up the total costs, finding 2, Schedule D, made it up by arithmetical processes which were based upon and took into consideration the shop or manufacturing costs of the individual valves included in the defendants' account.

(Master's note 55.—I find as requested.)

59 Twenty-fifth request for findings of fact. That without consideration of the prices returned by the defendants as received by them for individual valves or for separate lots of valves, and the prices returned by defendants as the manufacturing costs of individual valves included in the finding 1, the master would have no basis for his account.

(Master's note 56.—I find as requested.)

Twenty-sixth request for findings of fact. That the item 7, for nickel-plating, $728.79, is an item which does not apply to all the valves made and sold by the defendants, but only to such valves as were nickel-plated (Master's note 57.—I find as requested to this

point), and that the defendants' sales account furnished information designating such valves. (Master's note 58.—I believe this is a true statement, though I am not certain that every nickel-plated valve sold by defendants is so designated in the sales account.)

Twenty-seventh request for findings of fact. That the item in Schedule D, finding 9, commissions, was an item which did not apply to all the valves sold by the defendants, but only to certain valves on which the commissions were paid (Master's note 59.—I find as requested to this point), and that defendants' sales account furnished the means of designating such valves, except in the case of Tillotson, and that defendants did not attempt to designate these valves, although they pretended to have paid the commissions on sales made by themselves.

(Master's note 60.—Defendants' sales account and the detailed statements which defendants filed relating to the commissions paid by them to Tillotson & Co. and to W. Dixie furnish the means of designating all the valves on which commissions were paid by the defendants.)

Twenty-eighth request for findings of fact. That the item, finding 11, Meady lever, $318.45, is an item which does not apply to all the valves sold, but only to such valves as had the Meady lever attachment, and that many of these valves are identified in papers before the master by the word "lever."

(Master's note 61.—I find as requested.)

60 Twenty-ninth request for findings of fact. That the percentage on sales caused by the allowance of the items, findings 4 to 11, inclusive, during the period included in the account 1184, was 4.05.

* * * * * * *

61 Forty-second request for findings of fact. That the allowances for general expenses found by the master, calculated as a percentage on sales, were, for the period—

(1)	from	Feb.	15,	1879,	to	April	30, 1880	24.61%
(2)	"	May	1,	1880,	"	"	" 1881	27.48%
(3)	"	"		1881,	"	"	" 1882	19.33%
(4)	"	"		1882,	"	"	" 1883	24.76%
(5)	"	"		1883,	"	Sept.	25, 1883	26.86%
(6)	"	Sept.	25,	1883,	"	April	30, 1884	26.56%
(7)	"	May	1,	1884,	"	Jan.	31, 1885	32.97%

(Master's note 66.—I find as requested.)

Forty-third request for findings of fact. That by calculating upon the selling price of each valve as returned by the defendants the allowance for these various business expenses borne by that particular valve may be ascertained on the system upon which this account is made up, and, if it cannot so be ascertained, the master is respectfully requested to point out a way in which it can be ascertained.

62 (Master's note 67.—If an account is to be made with each valve sold, the allowance for general expenses to be made to it can be ascertained by taking the proper percentage of the selling price. The other allowances made in findings 4 to 11, inclusive, may fairly be considered as distributed over the whole period of the accounting in each case, and, if so considered, they amount to 4.047 per cent. of the selling price, as stated in note 62, for the period covered by master's corrected Schedule D, and to 4.26 per cent., as stated in note 65, for the period covered by master's corrected Schedule E.)

Forty-fourth request for findings of fact. That according to defendants' accounts in case 1184, as presented to the master, it appears that defendants sold valves which did not return them costs and expenses thus calculated during the respective periods of the accounting as set forth in the following schedules, and that the cost price returned by the defendants is as stated in these schedules, and that the percentage on sales is as stated in these schedules.

(Master's note 68.—I find as requested, with the following exceptions:

1. The percentage on sales in Schedule 1 should be 28.66 instead of 28.70, but this error is so small that it makes no difference in the calculated percentages.)

* * * * * * *

Forty-fifth request for findings of fact. That by calculating the general expenses as a percentage on sales and the other allowances as a percentage on sales and adding these items to the de-
63 fendants' returned costs the cost of each valve according to the system adopted by the master can be determined, and the difference between this and the returned price received will show the profit and loss for each valve.

* * * * * * *

Forty-seventh request for findings of fact. The master is requested to report the facts as to the dividends paid during the period of this accounting in cash and stock and the surpluses returned during the period of this accounting at the end of each financial year of the defendant corporation to the secretary of state.

(Master's note 71.—This is new matter, not suggested by anything contained in the objections or requests filed by either party upon the submission of my first draft report or by anything contained in the second draft report. As I understand the practice in a master's office, all objections and requests affecting the first draft report should be filed upon the submission of that draft. No objections or requests can be properly filed upon the submission of a second draft report except such as are pertinent to the new matter contained in the second draft report. I will, however, consider this an accidental omission and will treat this request as if it were filed upon submission of my first draft report.

First, as to dividends. The dividends paid by the defendant company during the period covered by these accountings are shown by "defendants' reply to complainants' request for production of

records of defendants' board of directors," printed on pages 584, 585, and 586 of the Record of Proceedings before the Master.

Second, as to surpluses returned, etc. Jan. 14, 1886 (Record of Proceedings before the Master, page 371), counsel for complainants offered in evidence before me certified copies of certificates of condition of the defendant corporation for the years 1876 to 1884, inclusive, as filed in the office of the secretary of the Commonwealth.

64 Of these certificates those which were filed during the period covered by these accountings are as follows and make the following showings as to surpluses:

1879, dated May 14, 1879, shows surplus, May 13, 1879, of $13,649.26;

1880, dated June 14, 1880, shows surplus, May 11, 1880, of $29,483.16;

1881, dated May 19, 1881, shows surplus, May 10, 1881, of $44,867.27;

1882, dated May 18, 1882, shows surplus, May 9, 1882, of $75,031.74;

1883, dated July 5, 1883, shows surplus, May 15, 1883, of $26,143.39;

1884, dated June 20, 1884, shows surplus, May 20, 1884, of $35,429.02.)

As to the request for the designation of the evidence to be reported, complainants say:

First. No direct examination of any witness ought be reported except it is sustained by the cross-examination of the witness upon the points developed in the direct examination which is reported.

Second. That the complainants are not ready to designate what evidence they desire until they have exhausted their applications to the master for findings of fact; but that, if the defendants' request for evidence is granted, they desire that cross-examinations of the witnesses, whose evidence has to be reported, should be reported.

(Master's note 72.—See master's note 96.)

Forty-eighth request for findings of fact. (Master's note 73.—I find as requested in this forty-eighth request of the complainants for findings of fact, except as I have otherwise indicated in my notes 74 to 92, inserted in the text of this request.) The master is requested to find concerning valves in the annexed schedules that, with regard to the period from Feb. 15, 1879, to April 30, 1880, no one of the purchasers of 1¼-inch valves named in the schedules bought any valves of that size during the period at any other price than the one named, after the first scheduled purchase, and that the same was true with regard to the 1½-inch valves.

That the 2-inch valve was the first valve of that size sold to Farquhar, and that subsequently 2-inch valves were sold him at higher prices during the period.

65 That the 2½-inch valves sold to Sherburne & Co. included all the valves sold to Sherburne & Co. during the period of the accounting; that the 2½-inch valves sold to the Baldwin Loco-

motive Works include nearly all the 2½-inch valves sold them in the first business period after Jan. 1, 1880.

(Master's note 74.—The Baldwin Works purchased the 44 2½-inch valves which are included in Schedule 1, and they purchased no other 2½-inch valves between Jan. 1 and April 30, 1880.)

That the 2½-inch valves sold to the Brooks Locomotive Works March 18, 1880, were sold at a reduction of five dollars from previously prevailing prices, and the price was never advanced to them for this size of valves thereafter.

That the 3-inch valves sold the Baldwin Locomotive Works beginning April 30, 1880, were the first 3-inch valves sold them, and the price was not advanced to them thereafter except for "particular cases."

(Master's note 75.—I do not know to what the exception refers, or, perhaps I should say, I do not recall the "particular cases.")

That the 2-inch iron valve sold Richard Dobbins was the first valve sold him and the only valve which he kept during the period. The three valves sold to Dillon were the first valves sold him of any sort during the period of this accounting. The valve sold to the Vulcan Iron Works was the first valve sold them during the period of this accounting, and the only valve sold at the time. The valve sold C. E. Ashcroft was the first valve sold him during the period of this accounting.

The 2½-inch iron valve sold Stearns & Co. was the first valve sold them during the period of this accounting, and the only valve in the bill at that time. The one sold Pinkerton & Sons was the only valve sold them during the period of this accounting. The one sold the John Ashcroft Manufacturing Company was the first valve sold them and the only valve in the bill.

The 3½-inch iron valves sold Pusey, Jones & Co. were all the valves sold them during the period of this accounting.

66 For the period from May 1, 1880, to April 30, 1881, the 1½-inch valves sold Marshall, Graves & Co. were at a reduction from previous prices, and the price was afterwards advanced to the old prices. Those sold Seymour, Sabine & Co. were the first valves sold them during the period of this accounting. Those sold C. Aultman & Co. were sold at a reduction of $1.25 from previously prevailing prices, and the price was not thereafter advanced, and except six 1½-inch valves were all the valves purchased during this business year by said Aultman. Those sold Talbot & Sons were sold at a similar reduction of $1.25 each from previously prevailing prices, and no higher price for this sort of valve was subsequently charged them. Those sold to A. B. Farquhar were sold at a similar reduction of price, and this reduction was not maintained to him, but an advance was made from $3.75 to $4.00 in the next business year.

Those sold to Russell & Co. were sold at a similar reduction from previously prevailing prices, the price to them up to the 14th of August, 1880, having been $5 a valve, on Oct. 23 one valve being sold them for $4.50, and the subsequent price made to them being $3.75, which was continued in following years. Those sold at $3.85 to Birdsall were at a reduction of $1.15 from previously pre-

vailing prices, and the price was not subsequently advanced in this or later business years. Those sold at $3.87½ to the Harrison Machine Works were at a reduction of $1.12½ from preceding prices, and the price was not subsequently advanced to them (Master's note 76.—Two valves were sold to the Harrison Machine Works at $4, one July 12, and another Sept. 21, 1882), and they were not, during the whole period of the accounting, purchasers of any other kind of valves, except on one occasion in 1883 when they bought a 2-inch iron valve. Those sold to Marshall, Graves & Co. were at a reduction from prices which had previously prevailed of 62½ cents. Marshall, Graves & Co. were not at this time purchasers of any other kind of valves, and did not become such purchasers, and then only to a small extent, until the last part of May, 1881. The valves sold at $3.90 to Frick & Co. were sold at a reduction from previously prevailing prices of twenty cents. Those sold at $4 to the Atlas Engine Works were at the same price that that company had been purchasing for a year. Those sold Stevens, Turner & Burns
67 were at a reduction of twenty-five cents from previously prevailing prices. (Master's note 77.—Four valves were sold May 14, 1880, at $4.25.) Those sold James Leffel & Co. were the first valves sold him, and this price was continued to him during the period of the accounting. Those sold to Robinson & Cary were at a price which had been prevailing to them since the beginning of the year 1880. Those sold the Watertown Steam Engine Company were at a reduction from the only previous valve sold them of fifty cents each. The Watertown Steam Engine Company subsequently purchased other sorts of valves. Those sold the Niles Tool Works were all the valves purchased by them during the period of this accounting. Those sold Chandler & Taylor were the first valves sold that firm, and the price was continued to them until October, 1882. Those sold J. F. Mundy were the first valves bought by him, and he bought but one other valve, a one and one-half inch, at $7.50, during this business year. Those sold P. K. Dederick were the first valves sold to him and all the valves sold him during this business year. Those sold the Porter Manufacturing Company were the first valves sold them and all the valves sold them during this business year. Those sold the Gibbs & Sterrett Manufacturing Company were the first valves sold them and all the valves sold them during this business year. Those sold the Ames Iron Works were at a reduction of 50 cents from previously prevailing prices. They were the first valves sold the Ames Iron Works for more than a year. Those sold William E. Turner & Co. were at a reduction of $1 from the price given for a single valve purchased in October, 1880. They were all the valves that Turner bought during the period of the accounting. Those sold Richard Tozer were at a reduction of $1 from the previously prevailing price. This was the last bill of goods bought by Tozer.

The 2-inch valves sold at $7.25 to Talbot & Sons were at a reduction from previously prevailing prices of $2.75. The one to the Silsby Manufacturing Company at $6.00 was the first valve sold them and the only valve included in that bill or furnished them

until two months later. The price was not continued to the Silsbee Manufacturing Company.

The 2½-inch valves at $13.25, sold the Baldwin Locomotive
68 Works, were nearly all the valves of that size purchased by them in that period. (Master's note 78.—Sixteen additional 2½-inch valves were sold to the Baldwin Locomotive Works at $13.25, as follows: Feb. 12, 1881, 10; Feb. 23, 1881, 4; Feb. 25, 1881, 2.) They bought no other valves but 3-inch valves. They paid no higher prices except in particular cases. (Master's note 79.—I do not recall the "particular cases.") The valve sold at $15 to the Mason Machine Works was the first valve sold them, and the price was continued on these valves during the period of the accounting. Those sold the Rhode Island Locomotive Works were the first valves bought by them in the period of this accounting, and the price was not varied. They bought no other valves except 3-inch. Those sold the Brooks Locomotive Works were at the price reached during the preceding year. Those sold the Pittsburgh Locomotive Works were the first valves sold them. They bought no others except 2½ and one 3-inch valve. Those sold the Danforth Locomotive Works were at a reduction of $5 from prices previously prevailing. The first sales were made to them during the current business year. They bought no other size of valves. Those sold to the Taunton Locomotive Manufacturing Company at $14.50 were the first valves bought by them—the only valves bought by them during the current year—and they paid higher prices for subsequent purchases of the same sized valve.

All the 3-inch valves scheduled were sold to the Baldwin Locomotive Works, who bought no other valves, except 2½.

The 2-inch iron valve sold to Dillon was sold at $2 less than he had been paying previously for the same size of iron valve.

The various 2½-inch iron valves sold to Babcock & Wilcox were all the iron valves of that size bought by them in this business year. The 2½-inch iron valves sold G. W. Tifft, Sons & Company were at a reduction of $3.75 from previous iron valves of the same sort sold them, and the low price was not continued.

The various 3-inch iron valves sold to Babcock & Wilcox at various prices comprise all the valves of that size sold to them during that period. The 3-inch iron valves sold at $25 to the Duplex Safety
69 Boiler Company were the first valves bought by them, and all the valves bought by them in that bill, and all but one of the valves bought by them in the current business year.

The 3½-inch iron valve sold to Babcock & Wilcox was the only valve of that size bought by them in the business year. Those sold to Gaar, Scott & Co. were all the valves of that size bought by them in the business year. Those sold to Sellers & Popple, Park & Lacey, and W. F. Lyons & Co. were all the valves of that size bought by them during the business year, and neither Lyons & Co. nor Sellers & Popple purchased more than one other valve each in the whole period of the accounting. The 3½-inch iron valves sold the Whittier Machine Company were the only valves of this size sold them during the business year. The valve sold Christy & De Graff was the only

valve of the size sold them in that year. They bought no other valve in that year but 4-inch.

The 4-inch valves sold Babcock & Wilcox were all the 4-inch iron valves bought by them in the business year. All the Babcock & Wilcox valves of the business year are included in this schedule. The 4-inch valves sold the Whittier Machine Company are all the 4-inch valves bought by them during the business year, and, with the valves already enumerated, make all the valves bought by them during the year. The 4-inch valves sold the King Iron Works were the first valves sold them, and all the valves bought by them during the business year. Those sold to the Coyhage Steam Furnace Company were all the valves ever bought by them. The valves sold E. H. Clapp were all the valves he ever bought. The 4-inch valves sold Park & Lacey were all the 4-inch valves bought by them during the period of this accounting. The 4-inch valve sold Dillon was the first and only 4-inch valve sold him during the period of the accounting.

That during the period from May 1, 1881, to April 30, 1882, of the valves scheduled the sales to customers not before mentioned, and to those who had reduction of price, were as follows:

William Haggert, 12 1¼-inch valves at $3.05, being a reduction of $1.20 from previous prices, and although the price of $3.05 was not continued to him, yet an allowance of $25.65, by item 51, was
70 made on his bill at about that date, which seems sufficient to more than reduce the 24 valves previously and subsequently sold at the price of $4.25 to an average price of rather less than $3.05.

(Master's note 80.—W. & F. Haggert purchased 43 1¼-inch valves from Sept. 25, 1879, to Aug. 20, 1881—

For which they were charged	$173 10
An allowance was made them of	25 65
Leaving amount paid by them	$147 45

This would make the average price of their 43 valves $3.43.)

At $3.50: Stevens, Turner & Burns had been previous customers at $4, and these 36 valves were the last of their purchases.

Haggert Bros. Manufacturing Company had purchased previously at $4.50, and their subsequent purchases were at this rate, except the last one, Aug. 28, 1883, at $3.75.

(Master's note 81.—Subsequent purchases, except that of Aug. 28, 1883, were at $3.50.)

At $3.70: E. Leonard & Sons. Their previous lowest rate had been $3.80. The price for this size of valve was not advanced.

At $3.75: The Geiser Manufacturing Company was a new customer. The bill of Dec. 17 was their only bill. It included 3 other 1-inch valves at the same price.

The valves at $3.80 were all sold to E. Leonard & Sons, a reduction of 20 cents from their first purchase, they becoming purchasers in this business year.

All valves at $3.85 were sold to E. M. Birdsall & Co. and were a reduction from a last previous price of $5. This price was never advanced, and was held until Aug. 13, 1883, when it was reduced to $3.50.

(Master's note 82.—The last sale at $5 was Aug. 28, 1880, and the first sale at $3.85 was Feb. 21, 1881.)

The valves at $3.88½ to the Gibbs & Sterrett Manufacturing Company were at a reduction from a previous price of $4.

The 1½-inch valves at $4.25 were sold to Frick & Co., and were at a reduction from the last preceding price of $5.50.

The 2-inch valves at $7.25 were to Talbot & Sons, and were at the same price of some previous sales.

71 (Master's note 83.—The sales in 1879 and 1880 were at $10. Commencing with Jan. 15, 1881, they were at $7.25, and continued at that price during the period of the accounting in No. 1184.)

The 2¼-inch valve to Hay & Prentice was the only valve of that size bought by them. It was part of a considerable bill of the 9th of December, 1881.

The 2½-inch valves at $13.25 included all but 50 valves purchased by the Hinkley Locomotive Works during the business year. 2 2-inch valves were bought at $12 and, previously, 48 2½ inch at $13.50.

The 2½-inch valve at $8.75 was the only valve ever bought by W. A. Short.

The 1 valve at $13 to the Baldwin Locomotive Works is charged as a particular case.

The 20 valves to the Canadian Locomotive and Engine Company at $13.50 were the first valves sold to them. This price was continued to them.

The valves to the Grant Locomotive Works at $15 were the first valves sold to them. They bought no others in this business year and nothing else but iron valves in the next.

(Master's note 84.—The Grant Locomotive Works purchased 3 2½-inch valves Aug. 15, 1882.)

The valves to the Mason Machine Works were the second lot of valves they had ever purchased.

The valves to the Brooks Locomotive Works were nearly all the valves bought by them during the business year. The others were 2½-inch valves at the same price.

(Master's note 85.—The Brooks Locomotive Works purchased 3 2½-inch valves in September, 1880, at $20.)

The valves to the Danforth Locomotive and Machine Company were the last valves purchased by them. The price to them had never varied.

The valves to the Pittsburgh Locomotive and Car Works were all the valves purchased by them during the business year.

The valves to Hay & Prentice were part of the same bill of Dec. 9 already referred to.

72 The valves to John Davis & Co., which were returned, were in the first bill of goods sent to them.

The valve to the Rhode Island Locomotive Works was the only valve sold them during the business year.

The 3-inch valves to Ripley & Kimball at $19.50 were part of a somewhat large bill of that day.

Among the iron valves the 48 3-inch iron valves comprise 37 to Babcock & Wilcox and 6 to the Whittier Machine Company.

The 166 3½-inch iron valves sold at $24 all went to Babcock & Wilcox.

The 163 4-inch iron valves sold at $28 all went to Babcock & Wilcox.

The *3* sold at $30 went, 2 of them to the King Iron Works and 2 to the National Tube Works Company.

The King Iron Works had bought 4-inch iron valves before at the rate of $38.50.

This was the first purchase of an iron valve by the National Tube Works Company, and they had only made one purchase before.

The 4-inch iron valves at $32.50, which went to the Whittier Machine Company, comprise all the 4-inch iron valves bought by them in the business year. There was no change of price to them.

The 5-inch iron valves at $46 were sold to the Globe Iron Works, and this was their first bill, and the only other item in the bill was 4 4-inch iron valves at $38.50.

That during the period from May 1, 1882, to April 30, 1883, the valves sold at a loss, or less than nine per cent. profit, were as follows: To Garr, Scott & Co., at a reduction from the last prevailing price of $4.50 to $3. To the Atlas Engine Works, a reduction from a last preceding price of $4 to $3.25. The Erie City Iron Works, a reduction from a last prevailing price of $3.50 to $3.25. The Ames Iron Works, a reduction from a last prevailing price of $4 to $3.50, and a subsequent reduction to 3.49\frac{27}{100}$, followed by an advance to $3.50. The price of 3.49\frac{27}{100}$ probably was an error in not charging the odd cents of the bill. Prescott, Scott & Co., at $3.50, their first order. Noble & Hall, at $3.50, their first order. North-
73 western Car Manufacturing Company, a reduction from a last prevailing price of $3.75. (Master's note 86.—The Northwestern Car Manufacturing Company had purchased no 1¼-inch valves before Jan. 15, 1883, and all their subsequent purchases were at $3.50, except one March 6, 1883, of a single valve at $3.75.) Skinner & Wood, Ames & Kane, first orders, at $3.50.

1½-inch valves, Prescott, Scott & Co., first order, at $3.50.

2½-inch valves scheduled were to old customers, and so also the 3-inch valves.

The 2-inch iron valves sold to W. H. Jenks at $6 were at a reduction from a last prevailing price of $12. (Master's note 87.—Subsequent sales to W. H. Jenks were all at $12.) 2½-inch iron valves sold at $5 to the Atlas Engine Works were at a reduction from a last prevailing price of $16.50.

The 3-inch iron valves sold at $16 to the New York Safety Steam Power Company were at a reduction from their last prevailing price of $26.

The valves scheduled as sold at a loss, or less than ten per cent.

profit, from May 1, 1883, to Sept. 25, 1883, were, in cases where there were alterations of prices or sales to new customers, as follows:

The 1½-inch valves at $3.40 to the N. O. Nelson Manufacturing Company were at a reduction from a last prevailing price of $4.

(Master's note 88.—The sales of 1½-inch valves to the N. O. Nelson Manufacturing Company, as shown in defendants' returns of sales, were: Sept. 22, 1882, 2 at $8; June 30, 1883, 2 at $3.40 and 2 at $6.)

3-inch valve to Hunnicut & Billingrath at $17.25, part of their first and only bill; 3-inch iron valves at $19.50, Atwood & McCaffrey, a reduction from a last prevailing price of $28. North Star Iron Works, part of the only bill; W. H. Perry, part of first bill; King Iron Works, a reduction from the last prevailing price of $26; D. H. Jerome, Michigan Iron Works, J. J. Howden, Buckeye Bridge and Boiler Works, part of first and only bill; James Clements & Son, second purchase, they being a customer of this year.

4-inch iron valves sold at $30, James Clements & Son, first
74 purchase; D. H. Jerome and J. J. Howden, part of first and only bill. At $33, Michigan Iron Works, part of first and only purchase.

5-inch iron valves at $47.25, Wilson & Howdrie, first purchase.

During the period from Sept. 25, 1883, to April 30, 1884, the valves sold at a loss were when sold to previous customers at a reduction from former prevailing prices or when sold to new customers as follows:

1¼-inch valves, Gaar, Scott & Co., at $2.85, were at a reduction from the last prevailing price of $3; at $2.80 to T. M. Nagle at a reduction from a last prevailing price in December, 1883, of $3.50.

3-inch iron valves at $16.50 to John Taylor & Bros. at a reduction from a last prevailing price of $22.50.

3½-inch iron valves at $18.08⅓, William Allen & Sons, at a reduction from $35 in March, 1882, and $24 on Jan. 3, 1884; at $22 to John Taylor & Bros., at reduction from $25.50 in January, 1884.

4-inch iron valves at $28 to Atlantic Dredging Company, first sale.

5-inch iron valves at $37.50 to Cook & Co. and Charles Perks.

6-inch iron valves to Charles Perks were sales to new customer.

The valves sold at a loss in the period from May 1, 1884, to Jan. 31, 1885, were when sold to old customers at reduced rates from former prices and when sold to new customers as follows:

1¼-inch valves at $2.50 to T. M. Nagle were at a reduction from the price of $2.80, Dec. 17, 1884; to A. B. Farquhar were at a reduction from $4, Oct. 25, 1884; at $2.75 to Erie City Iron Works at a reduction from $3, May 5, 1884; at $2.77½, which was afterwards reduced to $2.42½, the Erie City Iron Works, at a reduction from $2.75. The 1½-inch valves sold to T. M. Nagle at $3.35 were at a reduction from the last prevailing price of $4.25, Aug. 31, 1884. (Master's note 89.—I do not find the sale of 12 1½-inch valves, Jan. 27, 1885, to T. M. Nagle, nor do I find any sale of 12 1½-inch valves

at $3.35 to any one in January, 1885. I do find a sale of 12 1½-inch valves, Jan. 21, 1885, to Erie City Iron Works at $3.75.) At $3.50 to Erie City Iron Works at a reduction from $3.75, May 5, 1884; Mansfield Machine Works at a reduction from $4, July 11,
75 1884. 3-inch iron valves at $15, John Taylor & Brothers, at a reduction from $16.50, Aug. 1, 1884; at $16.25, Erie City Iron Works, at a reduction from $19.50, March 2, 1883. 3½-inch iron valves at $20, William Allen & Sons, at a reduction from $24, July 19, 1884.

4-inch iron valves at $25 to Ripley & Kimball at a reduction from $30, June 19, 1883; at $27 to Adolphus Meiers & Co., first and only purchase.

5-inch iron valves at $37.50 to Buhl Iron Works, first and only purchase; at $40, Phœnix Iron Works, the fourth valve bought by them; $40.50, King Iron Works, an advance from $37.50, May 19, 1882.

And that during the period from Sept. 25, 1883, to April 30, 1884, the following reductions were made to large customers:

Frick & Co., 1¼-inch valves, from $3.50 to $3.25 on 480 valves; 2-inch valves, from $8 to $7.50 for 26 valves. (Master's note 90.—Frick & Co. purchased 1¼-inch valves, 65 from Sept. 26, 1883, to Jan. 29, 1884, at $3.50, and 170 from March 10 to April 17, 1884. They also purchased 20 2-inch valves at $7.50, their previous purchase in August, 1882, being at $8.) Harrison Machine Works, from $3.75 to $3.25 on 60 1¼-inch valves; James Leffel & Co., from $4 to $3 on 75 1¼-inch valves; Reynolds & Lang, $7 to $4.75 on 1 1¼-inch valve; Talbot & Sons, from $3.75 to $3.50 on 72 1¼-inch valves, from $5.50 to $4.50 on 24 1½-inch valves, and to $3.50 on 6 1½-inch valves.

(Master's note 91.—Talbot & Sons purchased 1¼-inch valves, 12, Nov. 21, 1883, at $3.75, and 12, April 9, 1883, at $3.50; 1½-inch valves, 6, Nov. 8, 1883, at $5.50; 6, Feb. 29, 1884, at $3.50, and 12, April 9, 1884, at $4.50. These were all the 1¼-inch and 1½-inch valves purchased from Sept. 25, 1883, to April 30, 1884.)

Between April 30, 1884, and Jan. 31, 1885, the following reductions were made to large customers:

C. Aultman & Co., 1¼-inch valves, from $3.75 to $3 on 85 valves; Russell & Co., from $3.75 to $3.40 on 399 1¼-inch valves, and from $6 to $5.25 on 72 1½-inch valves; and defendants further
76 offered to reduce the price on 1¼-inch valves to Russell & Co. to $2.75; Mansfield Machine Works, from $4 to $3.50 on 10 1½-inch valves.

(Master's note 92.—The first reduction to Russell & Co. on 1¼-inch valves from $3.75 to $3.40 was Jan. 26, 1884; 410 1¼-inch valves were sold to Russell & Co. at $3.40 between April 30, 1884, and Jan. 31, 1885. The first reduction to Russell & Co. on 1½-inch valves from $6 to $5.25 was Jan. 26, 1884; 48 1½-inch valves were sold to Russell & Co. at $5.25 between April 30, 1884, and Jan. 31, 1885. I do not now recall any evidence before me upon which I can find

that "the defendants further offered to reduce the price on 1¼-inch valves to Russell & Co. to $2.75.")

THOS. WM. CLARKE,
Complainants' Counsel.

LAW ASSOCIATION PHILADELPHIA

COMPLAINANTS' SCHEDULE 1.

Valves Sold at a Loss, or Less Than 10% Profit, in Period from Feb. 15, 1879, to Apr. 30, 1880.

Sizes.	Prices.	Ret'd costs.	28.70% of price.	Total cost.	No. valves sold.	Profit each.	Loss each.	Gross loss.	
1 & 1¼"	4.00	2.50	1.15	3.65	**192**	.35			
1½"	5.00	3.38	1.43	4.81	**25**	.19			
2 "	8.00	5.13	2.29	7.42	**1**	.58			
2½"	12.00	10.11	3.44	13.55	1		1.55	1.55	
	13.10		3.75	13.86	60		.76	45.60	
	13.25		3.79	13.90	44		.65	28.60	
	15.00		4.30	14.41	**43**	.59			
Total ---------2½"					105				75.75
3 "	18.55	14.00	5.32	19.32	20		.77	15.40	15.40
Total brass valves at loss ----------					125				91.15
Iron.									
2 "	12.00	7.87	3.44	11.31	**6**	.69			
2½"	20.00	12.50	5.73	18.23	**3**	1.76			
3½"	35.00	23.00	10.08	33.02	**3**	1.97			

77 *Remarks Accompanying Schedule* 1.

The 1¼" valves were sold Feb. 10 & Apr. 20, 1880, to Robinson, Carey & Co., 11; Jan. 19, 1880, to Scheidler & Macnamara, 1; and Dec. 16, 1879, Jan. 16, 1880, Feb. 15, Mar. 23, & Apr. 30, to Atlas Engine Co., 180. No other valves of these sizes were bought by these parties after their first purchase at any other price.

The 1½" valves were sold Dec. 27, 1879, to Ames Iron Works, and were the only 1½ valves bought by them.

The 2" valve was sold to A. B. Farquhar & Co., Apr. 16, 1879 was the first 2" valve sold them.

The 2½" valves were sold Sherburne & Co., Mar. 31, 1880, 60 @ $13.10; Baldwin Locomotive Works, Jan. 10 & 31, Mar. 31 & Apr. 30, 1880, 44 @ $13.25; G. T. McGlauthlin & Co., Nov. 1, 1879, @ $12.00; Sherburne & Co., Feb. 18 & 28, 1880, 14 @ $15; Brooks Loco. Works, Mar. 18 & Apr. 22, 1880, 29 @ $15.

at $3.35 to any one in January, 1885. I do find a sale of 12 1½-inch valves, Jan. 21, 1885, to Erie City Iron Works at $3.75.) At $3.50 to Erie City Iron Works at a reduction from $3.75, May 5, 1884; Mansfield Machine Works at a reduction from $4, July 11,
75 1884. 3-inch iron valves at $15, John Taylor & Brothers, at a reduction from $16.50, Aug. 1, 1884; at $16.25, Erie City Iron Works, at a reduction from $19.50, March 2, 1883. 3½-inch iron valves at $20, William Allen & Sons, at a reduction from $24, July 19, 1884.

4-inch iron valves at $25 to Ripley & Kimball at a reduction from $30, June 19, 1883; at $27 to Adolphus Meiers & Co., first and only purchase.

5-inch iron valves at $37.50 to Buhl Iron Works, first and only purchase; at $40, Phœnix Iron Works, the fourth valve bought by them; $40.50, King Iron Works, an advance from $37.50, May 19, 1882.

And that during the period from Sept. 25, 1883, to April 30, 1884, the following reductions were made to large customers:

Frick & Co., 1¼-inch valves, from $3.50 to $3.25 on 480 valves; 2-inch valves, from $8 to $7.50 for 26 valves. (Master's note 90.—Frick & Co. purchased 1¼-inch valves, 65 from Sept. 26, 1883, to Jan. 29, 1884, at $3.50, and 170 from March 10 to April 17, 1884. They also purchased 20 2-inch valves at $7.50, their previous purchase in August, 1882, being at $8.) Harrison Machine Works, from $3.75 to $3.25 on 60 1¼-inch valves; James Leffel & Co., from $4 to $3 on 75 1¼-inch valves; Reynolds & Lang, $7 to $4.75 on 1 1½-inch valve; Talbot & Sons, from $3.75 to $3.50 on 72 1¼-inch valves, from $5.50 to $4.50 on 24 1½-inch valves, and to $3.50 on 6 1½-inch valves.

(Master's note 91.—Talbot & Sons purchased 1¼-inch valves, 12, Nov. 21, 1883, at $3.75, and 12, April 9, 1883, at $3.50; 1½-inch valves, 6, Nov. 8, 1883, at $5.50; 6, Feb. 29, 1884, at $3.50, and 12, April 9, 1884, at $4.50. These were all the 1¼-inch and 1½-inch valves purchased from Sept. 25, 1883, to April 30, 1884.)

Between April 30, 1884, and Jan. 31, 1885, the following reductions were made to large customers:

C. Aultman & Co., 1¼-inch valves, from $3.75 to $3 on 85 valves; Russell & Co., from $3.75 to $3.40 on 399 1¼-inch valves, and from $6 to $5.25 on 72 1½-inch valves; and defendants further
76 offered to reduce the price on 1¼-inch valves to Russell & Co. to $2.75; Mansfield Machine Works, from $4 to $3.50 on 10 1½-inch valves.

(Master's note 92.—The first reduction to Russell & Co. on 1¼-inch valves from $3.75 to $3.40 was Jan. 26, 1884; 410 1¼-inch valves were sold to Russell & Co. at $3.40 between April 30, 1884, and Jan. 31, 1885. The first reduction to Russell & Co. on 1½-inch valves from $6 to $5.25 was Jan. 26, 1884; 48 1½-inch valves were sold to Russell & Co. at $5.25 between April 30, 1884, and Jan. 31, 1885. I do not now recall any evidence before me upon which I can find

that "the defendants further offered to reduce the price on 1¼-inch valves to Russell & Co. to $2.75.")

THOS. WM. CLARKE,
Complainants' Counsel.

LAW ASSOCIATION PHILADELPHIA

COMPLAINANTS' SCHEDULE 1.

Valves Sold at a Loss, or Less Than 10% Profit, in Period from Feb. 15, 1879, to Apr. 30, 1880.

Sizes.	Prices.	Ret'd costs.	28.70% of price.	Total cost.	No. valves sold.	Profit each.	Loss each.	Gross loss.	
1 & 1¼"	4.00	2.50	1.15	3.65	**192**	.35			
1½"	5.00	3.38	1.43	4.81	**25**	.19			
2 "	8.00	5.13	2.29	7.42	**1**	.58			
2½"	12.00	10.11	3.44	13.55	1		1.55	1.55	
	13.10		3.75	13.86	60		.76	45.60	
	13.25		3.79	13.90	44		.65	28.60	
	15.00		4.30	14.41	**43**	.59			
Total ----------2½"					105				75.75
3 "	18.55	14.00	5.32	19.32	20		.77	15.40	15.40
Total brass valves at loss ----------					125				91.15
Iron.									
2 "	12.00	7.87	3.44	11.31	**6**	.69			
2½"	20.00	12.50	5.78	18.23	**3**	1.76			
3½"	35.00	23.00	10.08	33.02	**3**	1.97			

77 *Remarks Accompanying Schedule* 1.

The 1¼" valves were sold Feb. 10 & Apr. 20, 1880, to Robinson, Carey & Co., 11; Jan. 19, 1880, to Scheidler & Macnamara, 1; and Dec. 16, 1879, Jan. 16, 1880, Feb. 15, Mar. 23, & Apr. 30, to Atlas Engine Co., 180. No other valves of these sizes were bought by these parties after their first purchase at any other price.

The 1½" valves were sold Dec. 27, 1879, to Ames Iron Works, and were the only 1½ valves bought by them.

The 2" valve was sold to A. B. Farquhar & Co., Apr. 16, 1879 was the first 2" valve sold them.

The 2½" valves were sold Sherburne & Co., Mar. 31, 1880, 60 @ $13.10; Baldwin Locomotive Works, Jan. 10 & 31, Mar. 31 & Apr. 30, 1880, 44 @ $13.25; G. T. McGlauthlin & Co., Nov. 1, 1879, @ $12.00; Sherburne & Co., Feb. 18 & 28, 1880, 14 @ $15; Brooks Loco. Works, Mar. 18 & Apr. 22, 1880, 29 @ $15.

The 3″ valves were sold Baldwin Loco. Works, Apr. 30, 1880, 20 @ $18.55.

The 2″ iron valves were sold 1879, Mar. 1, to Richard Dobbins, 1; Mar. 3 & 6, to D. M. Dillon, 3; Apr. 21, to Vulcan Iron Works, 1; 1880, Apr. 30, to E. E. Ashcroft, 1.

The 2½″ iron valves were sold 1879, Mar. 31, to Stearns M'f'g Co., 1; Apr. 28, Pinkerton & Sons, 1; 1880, Mar. 31, John Ashcroft M'f'g Co., 1.

The 3½″ iron valves were sold 1879, Mar. 31, to Pusey, Jones & Co., 1; and Aug. 15 to same, 2.

COMPLAINANTS' SCHEDULE 2.

Valves Sold at a Loss, or Less Than 8% Profit, in Period from May 1, 1880, to April 30, 1881.

Sizes.		Prices.	Ret'd costs.	31.53% of price.	Total cost.	No. valves sold.	Profit each.	Loss each.	Gross loss.	
	1¼″	3.45⅝	2.43	1.09	3.52	24		.06¼	1.60	
		3.50		1.10	3.53	100		.03	3.00	
		3.75		1.18	3.61	**522**	.14			
		3.85		1.21	3.64	**75**	.21			
		3.87½		1.22	3.65	**120**	.22½			
		3.90		1.23	3.66	**100**	.24			
		4.00		1.26	3.69	**228**	.31			
Total	1¼″					124				4.60
	2 ″	6.00	4.75	1.89	6.64	1		.64	.64	
		7.25		2.28	7.03	**18**	.22			
Total	2 ″					1				.64
78	2½″	13.25	9.62	4.17	13.79	61		.54	32.94	
		15.00		4.73	14.35	**178**	.66			
		14.50		4.57	14.19	**18**	.31			
Total	2½″					61				32.94
	3 ″	18.55	13.15	5.84	18.99	36		.44	15.84	15.84
Total brass valves at loss						222				54.02
Iron.										
	2 ″	10.00	7.00	3.15	10.15	1		.15	.15	.15
	2¼″	16.00	11.25	5.04	16.29	2		.29	.58	.58
	2½″	15.00	11.25	4.73	15.98	6		.98	5.88	
		18.00		5.68	16.93	**1**	1.07			
		18.75		5.91	17.16	**4**	1.59			
Total	2½″					6				5.88

	3 ″	17.00	.16	5.36	21.36	4		4.36	17.44
		19.50		6.14	22.14	6		2.64	15.84
		20.00		6.31	22.31	1		2.31	2.31
		22.00		6.94	22.94	1		2.94	2.94
		25.00		7.88	23.88	3	1.12		
Total	3 ″					12			38.53
	3½″	26.00	21.50	8.19	29.69	1		3.69	3.69
		30.00		9.46	30.96	4		.96	3.84
		32.00		10.09	31.39	5	.41		
		32.50		10.25	31.75	2	.75		
		33.00		10.40	31.90	1	1.10		
Total	3½″					5			7.53
	4 ″	28.00	30.00	8.83	38.83	2		10.83	21.66
		30.00		9.46	39.46	1		9.46	9.46
		32.50		10.25	40.25	13		7.75	100.75
		38.00		11.98	41.98	9		3.98	35.82
		38.50		12.14	42.14	4		3.64	14.56
		40.00		12.61	42.61	4		2.61	10.44
Total	4 ″					38			192.69
Total iron valves at loss						59			$245.36

79 *List with Schedule* 2.

Classification of valves sold at a loss, or less than 8% profit, between May 1, 1880, and April 30, 1881.

1¼″.

April 6, 1881, 24 valves, at $3.45½, to Marshall, Graves & Co.
Feb. 15, 1881, 24 " " 3.50 " Seymour, Sabine & Co.
March 23, 1881, 76 " " 3.50 " " " "

At $3.75.

Oct. 9, 1880, 50 to C. Aultman & Co.
" 11, " 50 " " "
Nov. 17, " 50 " " "
Dec. 6, " 50 " " "
" 11, " 6 " Talbot & Sons.
Jan. 14, 1881, 50 " C. Aultman & Co.
" 15, " 24 " Talbot & Sons.
Feb. 10, " 50 " C. Aultman & Co.
" 25, " 36 " A. B. Farquhar.
March 7, " 50 " C. Aultman & Co.
" 29, " 6 " Talbot & Sons.
April 23, " 50 " Russell & Co.
" 27, " 50 " C. Aultman & Co.

522 in all.

At $3.85.

Feb. 23, 1881, 25 to E. M. Birdsall & Co.
March 24, " 25 " " " "
April 6, " 25 " " " "

At $3.87½.

Jan. 15, 1881, 24 to Harrison Machine Co.
Feb. 26, " 24 " Marshall, Graves & Co.
March 16, " 36 " Harrison Machine Co.
April 19, " 36 " " " "
120 in all.

80 At $3.90.

Feb. 2, 1881, 50 to Frick & Co.
April 2, " 50 " " "

At $4.00.

May 25, 1880, 36 to Atlas Engine Works.
July 10, " 8 " Stevens, Turner & Burns.
" 10, " 6 " James Leffel & Co.
" 29, " 6 " Stevens, Turner & Burns.
" 29, " 3 " Robinson & Carey.
Aug. 6, " 6 " Stevens, Turner & Burns.
" 21, " 12 " Watertown Steam Engine Co.
Sep. 10, " 12 " James Leffel & Co.
" 10, " 6 " Stevens, Turner & Burns.
" 20, " 2 " Robinson & Carey.
Oct. 12, " 6 " Niles Tool Works.
" 18, " 6 " Stevens, Turner & Burns.
Nov. 19, " 2 " Chandler & Taylor.
Dec. 1, " 3 " Robinson & Carey.
Dec. 30, " 1 " J. S. Mundy.
Jan. 14, 1881, 6 " P. R. Dederick.
" 21, " 6 " Porter Mnfg. Co.
" 31, " 4 " Robinson & Carey.
Feb. 28, " 6 " Stevens, Turner & Burns.
March 7, " 1 " Gibbs & Sterrett Mnfg. Co.
" 10, " 50 " Ames Iron Works.
" 19, " 4 " J. S. Mundy.
" 25, " 24 " William E. Turner & Co.
April 11, " 6 " Richard Tozer.
" 19, " 6 " Gibbs & Sterrett Co.
228 in all.

The 2″ valves were sold at $7.25 and at $6.00, July 20, 1880, to Silsby Mnfg. Co.

Jan. 15, 1881, 6 to Talbot & Co.
March 24, " 6 " " & Sons.
April 16, " 6 " " "

81 The 2½" valves sold at $13.25 were sold to Burnham, Parry, Williams & Co., of the Baldwin Locomotive Works, June 7, June 26, June 28, July 28, Aug. 17, Aug. 30, Sept. 1, Sept. 11, and Oct. 16, 1880.

61 in all.

Those sold at $15 were sold—

May	3, 1880,	1	to	Mason Machine Works.
June	7, "	24	"	R. I. Locomotive Works.
July	27, "	5	"	Brooks " "
"	28, "	22	"	Pittsburgh Locomotive Works.
Aug.	27, "	10	"	Brooks " "

(This price is taken from the price of July 27, where 2¼ and 2½ are rated at $15.00 each.)

Oct.	12, 1880,	12	to	Brooks Locomotive Works.
Dec.	1, "	10	"	" " "
"	1, "	20	"	Pittsburgh Locomotive & Machine Works.
"	24, "	30	"	Brooks Locomotive Works.
Feb.	12, 1881,	2	"	Pittsburgh Locomotive & Machine Works.
"	18, "	12	"	Brooks Locomotive Works.
March	17, "	12	"	Danforth " "
"	21, "	2	"	R. I. " "
April	8, "	16	"	Brooks " "
		178		

At $14.50.

June 7, 1880, Oct. 26, Nov. 15,
18 to Taunton Locomotive Mnfg. Co.

The 3" valves at $18.55 were sold, 36 in number—

June	30, 1880,	2	to	Burnham, Parry, Williams & Co.
Sept.	11, "	12	"	" " " " "
"	28, "	4	"	" " " " "
Dec.	21, "	9	"	" " " " "
Feb.	23, "	8	"	" " " " "
March	29, "	1	"	Baldwin Locomotive Works.

82 The 2" iron valve at $10 was sold

Dec. 2, 1880, to E. M. Dillon.

The 6 2½" iron valves at $15 were sold

April 27, 1881, to Babcock & Wilcox.

The 1 2½" iron valve at $18 was sold

March 30, 1881, to Babcock & Wilcox.

The 4 2½" iron valves at $18.75 were sold

June 24, 1880, to G. W. Tifft, Son & Co.

The 2 2¼″ iron valves were sold

July 31, 1880, to Park & Lacy, and Feb. 8, 1881, to H. J. Russell.

The 3″ iron valves at $19.50 were sold

April 29, 1881, 6 to Babcock & Wilcox.

4 3″ iron valves were sold at $17,

April 6, 1881, to Babcock & Wilcox.

1 3″ iron valve was sold at $20,

Jan. 8, 1881, to Babcock & Wilcox.

1 3″ iron valve was sold at $22,

March 30, 1881, to Babcock & Wilcox.

3 3″ iron valves were sold at $25,

April 22, 1881, to Duplex Safety Boiler Co.

Of 3 ½″ iron valves 1 was sold at $26,

March 30, 1881, to Babcock & Wilcox.

3 ½″ iron valves 1 was sold at $30,

Nov. 24, 1880, 4 to Gaar, Scott & Co.

83 3 ½″ at $32.

May 20, 1880, 1 to Sellers & Popple.
July 31, " 1 " Park & Lacy.
March 29, " 1 " W. F. Lyons & Co.
April 23, " 2 " Park & Lacy.

At $32.50.

April 6, 1881, 2 to Whittier Machine Co.

At $33.

March 2, 1881, 1 to Christy & De Grath.

4″ iron valves at $28.

April 29, 1881, to Babcock & Wilcox.

At $30.

March 30, 1881, 1 to Babcock & Wilcox.

At $32.50.

Nov. 8, 11, 12, 18, 20, 22, 1880, and March 28, 1881, 13 to Whittier Machine Company.

At $38.50.

June 19, 1880, 2 to King Iron Works.
Jan. 27, 1881, 2 " " " "

4

At $38.

March 1, 1881, 4 to Coyhage Steam Furnace Co.
" 21, " 3 " Christy & De Grath.
April 27, " 2 " E. A. Clapp.

9

At $40.

July 31, 1880, 1 to Park & Lacy.
Sept. 10, " 1 " E. M. Dillon.
April 23, 1881, 2 " Park & Lacy.

4

84 COMPLAINANTS' SCHEDULE 3.

Valves Sold at Loss, or Less Than 18% Profit, in the Period from May 1, 1881, to Apr. 30, 1882.

Sizes.	Price.	Ret'd cost.	23.38% of price.	Total cost.	No. valves sold.	Profit each.	Loss each.	Gross loss.	
1¼"	2.87½	2.34	.67	3.01	50		.13	6.50	
	3.05		.71	3.05	**12**	none	none		
	3.50		.82	3.16	**84**	.34			
	3.70		.87	3.21	**25**	.49			
	3.75		.88	3.22	**1337**	.53			
	3.80		.89	3.23	**64**	.57			
	3.85		.90	3.24	**125**	.61			
	3.88½		.91	3.25	**12**	.64			
	3.90		.91	3.25	**174**	.65			
	4.00		.94	3.28	**614**	.72			
Total ---- 1¼"					50				6.50
1½"	4.27	2.90	.99	3.89	**50**	.36			
2 "	7.25	4.25	1.70	5.95	**31**	1.30			
2½"	12.50	6.75	2.92	9.67	1	2.83			
2½	13.25	9.00	3.10	12.10	**94**	1.15			
	13.50		3.16	12.16	**68**	1.34			
	15.00		3.51	12.51	**268**	2.49			
	8.75		2.05	11.05	1		2.30	2.30	
	11.50		2.69	11.69	104		.19	19.76	
	13.00		3.04	12.04	**1**	.96			
Total---------- 2½					105				22.06

	3 ″	16.00	12.20	3.74	15.94	**224**	.06			
		19.50		4.56	16.76	**2**	2.74			
Total brass valves at loss						155				28.56
Iron.										
	2 ″	8.50	6.50	1.99	8.49	**2**	.01			
		9.00		2.10	8.60	**11**	.40			
		10.00		2.34	8.84	**2**	1.16			
		10.50		2.45	8.95	**25**	1.55			
	2½″	15.00	9.50	3.51	13.01	**22**	1.99			
		15.25		3.57	13.07	**2**	2.18			
		16.50		3.86	13.36	**2**	3.14			
85	3 ″	19.50	15.00	4.56	19.56	48		.06	2.88	
		22.50		5.26	20.26	**2**	2.24			
		22.75		5.32	20.32	**12**	2.43			
		25.00		5.85	20.85	**5**	4.15			
Total	3 ″					48				2.88
	3½″	24.00	20.00	5.61	25.61	166		1.61	267.26	
		26.00		6.08	26.08	1		.08	.08	
		28.00		6.55	26.55	**5**	1.45			
		32.00		7.48	27.48	**10**	4.52			
Total	3½″					167				267.34
	4 ″	28.00	26.00	6.55	32.55	163		4.55	741.65	
		30.00		7.01	33.01	3		3.01	9.03	
		32.50		7.60	33.60	12		1.10	13.20	
		35.00		8.18	34.18	**1**	.82			
		38.50		9.00	35.00	**4**	3.50			
		40.00		9.35	35.35	**5**	4.65			
Total	4 ″					178				763.88
	5 ″	43.75	36.00	10.23	46.23	2		2.48	4.96	
		46.00		10.75	46.75	3		.75	2.25	
		55.00		12.86	48.86	**5**	6.14			
Total	5 ″					5				7.21
Loss on iron valves						398				1,041.31
" " brass "						155				28.56
Total						553				1,069.87

List with Schedule 3.

During the period from May 1, 1881, to April 30, 1882, the defendants sold 1¼-inch valves—

At $2.87½.

May 17, 1881, 50 to Seymour, Sabine & Co.

At $3.05.

May 30, 1881, 12 to William Haggert.

At $3.50.

June 3, 1881, 12 to Stevens, Turner & Burns.
Aug. 20, " 12 " " " "
Sept. 12, " 12*" " " "
March 15, 1882, 60 " Haggert Bros. Mnfg. Co.

84

86 At $3.70.

Feb. 4, 1882, 25 to E. Leonard & Sons.

At $3.75.

May 11, 1881, 24 to Talbot & Sons.
" 25, " 50 " Russell & Co.
June 15, " 50 " Russell & Co.
July 8, " 25 " C. Aultman & Co.
" 25, " 31 " Russell & Co.
Aug. 9, " 25 " C. Aultman & Co.
" 9, " 19 " Russell & Co.
" 16, " 24 " Talbot & Sons.
" 20, " 25 " Seymour, Sabine & Co.
" 20, " 25 " Aultman & Co.
Sept. 3, " 50 " Russell & Co.
" 15, " 25 " Seymour, Sabine & Co.
" 15, " 25 " Frick & Co.
" 30, " 25 " Seymour, Sabine & Co.
Nov. 8, " 50 " C. Aultman & Co.
" 12, " 24 " Talbot & Sons.
" 30, " 25 " Russell & Co.
Dec. 3, " 12 " A. B. Farquhar.
" 17, " 3 " Geiser Mnfg. Co.
" 31, " 50 " C. Aultman & Co.
Jan. 24, 1882, 50 " " " "
" 28, " 50 " Russell & Co.
" 31, " 50 " Frick & Co.
Feb. 17, " 50 " Seymour, Sabine & Co.
" 27, " 50 " Russell & Co.
March 2, " 100 " Frick & Co.
" 15, " 50 " Russell & Co.
" 27, " 50 " C. Aultman & Co.
" 31, " 50 " Russell & Co.
April 13, " 50 " Seymour, Sabine & Co.
" 20, " 50 " Frick & Co.

*(Master's note 93.—This sale of Sept. 12, 1881, is not included in the footing.)

87

April 22, 1882, 24 to Talbot & Sons.
" 28, " 26 " " "
" 28, " 50 " Seymour, Sabine & Co.
" 29, " 50 " C. Aultman & Co.

1,337

1,337 at this price.

At $3.80 they sold—

June 9, 1881, 12 to E. Leonard & Sons.
" 28, " 28 " " " "
July 30, " 28 " " " "
Aug. 20, " 12 " " " "

64

At $3.85 they sold—

Jan. 25, 1882, 50 to E. M. Birdsall & Co.
April 1, " 50 " " " "
" 20, " 25 " " " "

125

At $3.88½ they sold—

Nov. 16, 1881, 12 to Gibbs & Sterrett Mnfg. Co.

At $3.90 they sold—

May 31, 1881, 50 to Frick & Co.
July 8, " 50 " " "
Oct. 14, " 24 " Marshall, Graves & Co.
" 25, " 50 " Frick & Co.

174

At $4 they sold—

May 13, 1881, 1 to J. H. Killy & Co.
" 13, " 12 " William Yates.
" 17, " 15 " Peck & Tracey.
" 17, " 12 " Gibbs & Sterrett Mnfg. Co.
" 19, " 1 " Farrar & Tripp.
" 20, " 12 " P. K. Dederick.

88

May 28, 1881, 36 to A. B. Farquhar.
June 2, " 6 " E. Leonard & Son.
" 3, " 4 " Farnham's Brass Works.
" 7, " 6 " Shaw, Kendall & Co.
" 9, " 1 " Robert Mitchell & Co.

"	14,	"	24	" Shaw, Kendall & Co.
July	1,	"	12	" J. Mattherson & Co.
"	23,	"	3	" H. King & Son.
Aug.	3,	"	5	" Robinson & Carey.
"	4,	"	6	" Gibbs & Sterrett Mnfg. Co.
"	4,	"	3	" Reynolds & Lang.
"	8,	"	36	" A. B. Farquhar.
"	9,	"	6	" Gibbs & Sterrett Mnfg. Co.
"	17,	"	10	" Robinson & Carey.
"	20,	"	36	" A. B. Farquhar.
"	20,	"	6	" J. H. Killy.
"	22,	"	4	" Peck & Tracey.
"	26,	"	1	" C. E. Ashcroft.
Sept.	12,	"	36	" A. B. Farquhar.
"	12,	"	12	" Gibbs & Sterrett Mnfg. Co.
"	16,	"	6	" James Jinks.
"	19,	"	10	" Robinson & Carey.
"	20,	"	4	" T. S. & A. J. Kirkwood.
"	24,	"	4	" John Griswold & Sons.
"	28,	"	2	" Gould & Ostrander.
"	30,	"	12	" Gibbs & Sterrett Mnfg. Co.
Oct.	14,	"	1	" Robinson Machine Works.
Nov.	19,	"	50	" Ames Iron Works.
"	22,	"	4	" Porter Mnfg. Co.
"	25,	"	12	" Watertown Steam Engine Co.
"	29,	"	1	" Phenix Foundry & Machine Co.
Dec.	7,	"	6	" L. D. Pollard.
"	9,	"	2	" Hay & Prentiss.
"	16,	"	1	" Lidgerwood Mnfg. Co.
"	22,	"	1	" C. E. Ashcroft.
"	28,	"	4	" H. L. Ide.

89

Jan.	31,	1882,	2	to H. & F. Blandy.
Feb.	2,	"	25	" A. B. Farquhar.
"	11,	"	6	" R. Schiedler & Co.
"	13,	"	1	" James Leffel & Co.
"	13,	"	1	" Phenix Foundry and Machine Co.
"	25,	"	2	" Ripley & Kimball.
"	27,	"	12	" William Heilman.
March	4,	"	1	" Rumsey & Seckmeier.
"	9,	"	6	" Chandler & Taylor.
"	18,	"	25	" A. B. Farquhar.
"	27,	"	25	" James Leffel & Co.
"	28,	"	6	" Lane & Bodley Co.
April	20,	"	12	" Gibbs & Sterrett Mnfg. Co.
"	22,	1882,	25	" James Leffel & Co.
"	26,	"	15	" Pierce, Butler & Pierce.
"	28,	"	24	" Shaw, Kendall & Co.

614 in all.

Of 1½″ valves at $4.25 they sold—

March 15, 1882, 6 to Frick & Co.
" 28, " 44 " Frick & Co.

50 in all.

2″ valves at $7.25 they sold—

Nov. 7, 1881, 1 to Talbot & Sons.
Aug. 16, " 6 " " "
Nov. 12, " 11 " " "
Feb. 15, 1882, 6 " " "
March 2, " 1 " " "
April 22, " 6 " " "

31 in all.

2¼″ valves at $12.50.

Dec. 9, 1881, 1 to Hay & Prentiss. Also were sold.
" 13, " 2 " John Davis & Co., which were returned.

90 2½″ valves at $13.25.

Aug. 17, 1881, 24 to Hinkley Locomotive Works.
Feb. 10, 1882, 24 " " " "
" 27, " 46 " " " "

94

At $8.75.

March 16, 1882, 1 to W. A. Short.

At $11.50.

May 27, 1881, 8 to Burnham, Parry, Williams & Co.
June 21, " 4 " " " " "
July 21, " 4 " " " " "
Aug. 23, " 4 " " " " "

which were returned.

" 30, " 6 " Burnham, Parry, Williams & Co.
Sept. 7, " 18 " " " " "
" 19, " 4 " " " " "
Oct. 25, " 6 " " " " "
Nov. 4, " 4 " " " " "
March 22, 1882, 50 " " " " "

104

At $13.

Sept. 7, 1881, 1 to Burnham, Parry, Williams & Co.

At $13.50.

July 7, 1881, 48 to Hinkley Locomotive Co.
Feb. 23, 1882, 20 " Canadian Locomotive & Engine Co.

68

At $15.

May 13, 1881, 6 to Grant Locomotive Works.
" 17, " 34 " " " "
April 8, 1882, 3 " " " "
May 23, 1881, 2 " Mason Machine Works,
1 of which was returned.

91

May 31, 1881, 18 to Mason Machine Works.
Jan. 24, 1882, 24 " " " "
March 23, " 24 " " " "
July 15, 1881, 12 " Brooks Locomotive Works.
Aug. 17, " 12 " " " "
Oct. 13, " 23 " " " "
Dec. 10, " 12 " " " "
" 31, " 24 " " " "
Feb. 17, 1882, 10 " " " "
March 3, " 12 " " " "
" 11, " 10 " " " "
April 26, " 10 " " " "
Sept. 30, 1881, 8 " Danforth Locomotive & Machine Works.
Nov. 25, " 12 " Pittsburgh Locomotive & Car Works.
Dec. 1, " 4 " " " " "
April 22, 1882, 4 " " " " "
Dec. 9, 1881, 2 " Hay & Prentiss.
" 13, " 10 " John Davis & Co.,
which were returned; item 59.
Dec. 22, 1881, 1 " R. I. Locomotive Works.
Mar. 20, 1882, 12 " Hay & Prentiss, 10 of which were returned; items 191 & 192.

268

536 in all.

3″ valves sold at $16.

May 9, 1881, 18 to Burnham, Parry, Williams & Co.
" 27, " 34 " " " " "
June 29, " 4 " " " " "
Aug. 12, " 1 " " " " "
" 30, " 21 " " " " "
Sept. 7, " 5 " " " " "
" 16, " 2 " " " " "
" 30, " 1 " " " " "
Oct. 25, " 14 " " " " "
" 26, " 1 " " " " "

Of 1½″ valves at $4.25 they sold—

March 15, 1882, 6 to Frick & Co.
" 28, " 44 " Frick & Co.

50 in all.

2″ valves at $7.25 they sold—

Nov. 7, 1881, 1 to Talbot & Sons.
Aug. 16, " 6 " " "
Nov. 12, " 11 " " "
Feb. 15, 1882, 6 " " "
March 2, " 1 " " "
April 22, " 6 " " "

31 in all.

2½″ valves at $12.50.

Dec. 9, 1881, 1 to Hay & Prentiss. Also were sold.
" 13, " 2 " John Davis & Co., which were returned.

90 2½″ valves at $13.25.

Aug. 17, 1881, 24 to Hinkley Locomotive Works.
Feb. 10, 1882, 24 " " " "
" 27, " 46 " " " "

94

At $8.75.

March 16, 1882, 1 to W. A. Short.

At $11.50.

May 27, 1881, 8 to Burnham, Parry, Williams & Co.
June 21, " 4 " " " " "
July 21, " 4 " " " " "
Aug. 23, " 4 " " " " "

which were returned.

" 30, " 6 " Burnham, Parry, Williams & Co.
Sept. 7, " 18 " " " " "
" 19, " 4 " " " " "
Oct. 25, " 6 " " " " "
Nov. 4, " 4 " " " " "
March 22, 1882, 50 " " " " "

104

At $13.

Sept. 7, 1881, 1 to Burnham, Parry, Williams & Co.

At $13.50.

July 7, 1881, 48 to Hinkley Locomotive Co.
Feb. 23, 1882, 20 " Canadian Locomotive & Engine Co.

68

At $15.

May 13, 1881, 6 to Grant Locomotive Works.
" 17, " 34 " " " " "
April 8, 1882, 3 " " " " "
May 23, 1881, 2 " Mason Machine Works,
1 of which was returned.

91

May 31, 1881, 18 to Mason Machine Works.
Jan. 24, 1882, 24 " " " " "
March 23, " 24 " " " " "
July 15, 1881, 12 " Brooks Locomotive Works.
Aug. 17, " 12 " " " " "
Oct. 13, " 23 " " " " "
Dec. 10, " 12 " " " " "
" 31, " 24 " " " " "
Feb. 17, 1882, 10 " " " " "
March 3, " 12 " " " " "
" 11, " 10 " " " " "
April 26, " 10 " " " " "
Sept. 30, 1881, 8 " Danforth Locomotive & Machine Works.
Nov. 25, " 12 " Pittsburgh Locomotive & Car Works.
Dec. 1, " 4 " " " " " "
April 22, 1882, 4 " " " " " "
Dec. 9, 1881, 2 " Hay & Prentiss.
" 13, " 10 " John Davis & Co.,
which were returned; item 59.
Dec. 22, 1881, 1 " R. I. Locomotive Works.
Mar. 20, 1882, 12 " Hay & Prentiss, 10 of which were returned; items 191 & 192.

268

536 in all.

3″ valves sold at $16.

May 9, 1881, 18 to Burnham, Parry, Williams & Co.
" 27, " 34 " " " " " "
June 29, " 4 " " " " " "
Aug. 12, " 1 " " " " " "
" 30, " 21 " " " " " "
Sept. 7, " 5 " " " " " "
" 16, " 2 " " " " " "
" 30, " 1 " " " " " "
Oct. 25, " 14 " " " " " "
" 26, " 1 " " " " " "

At $17.50.

Sept.	20,	1881,	2	to D. M. Dillon.
"	24,	"	1	" Vulcan Iron Works.
Oct.	11,	"	3	" H. S. Russell.
"	17,	"	1	" D. M. Dillon.
Nov.	8,	"	2	" Ripley & Kimball. 1 returned; item 156.
Nov.	11,	"	5	" D. M. Dillon.
Jan.	2,	1882,	1	" C. E. Ashcroft.
"	18,	"	1	" "
"	25,	"	1	" H. S. Russell.
"	"	"	1	" Atwood & McCaffery.
Feb.	11,	"	1	" C. E. Ashcroft.
"	27,	"	1	" James J. Driscoll.
Mar.	22,	"	2	" D. M. Dillon.
"	25,	"	1	" E. Hodge & Co.
			22	

3″ iron valves at $19.50.

June	3,	1881,	6	to Babcock & Wilcox.
Aug.	15,	"	6	" " "
Nov.	8,	"	1	" " "

95

Jan.	24,	1882,	6	to Whittier Machine Co.
"	25,	"	2	" Atwood & McCaffrey.
"	31,	"	1	" H. & F. Blandy. Returned.
March	8,	"	12	" Babcock & Wilcox.
"	28,	"	2	" Lane & Bodley Co.
April	1,	"	1	" Ball & Nailor.
"	29,	"	12	" Babcock & Wilcox.
			48	

At $22.50.

Jan.	30,	1882,	2	to Eaton, Cole & Burnham.

At $22.75.

Oct.	11,	1881,	2	to H. S. Russell.
"	17,	"	2	" Copeland & Bacon.
Nov.	16,	"	1	" Kendall & Roberts. Returned.
"	"	"	1	" F. S. Lynch.
Jan.	18,	1882,	1	" C. E. Ashcroft.
"	"	"	2	" Copeland & Bacon.
"	25,	"	1	" H. S. Russell.
"	28,	"	1	" E. E. Roberts.
Feb.	7,	"	1	" Arbendroth & Root Mnfg. Co. Returned.
March	6,	"	1	" E. Hodge & Co.
"	20,	"	1	" " " "
			12	

At $25.

June	3,	1881,	2	to Noble & Hall.
Aug.	2,	"	1	" Benton, Faulkner & Bird.
Sept.	22,	"	2	" E. McKay.
			5	

At $26.

June	22,	1881,	1	to H. S. Beach & Son.
Aug.	15,	"	5	" H. S. Russell.
Sept.	10,	"	1	" G. T. McLaughlin.
"	17,	"	3	" H. S. Beach & Son.
"	30,	"	1	" L. G. Tillotson.
Oct.	6,	"	1	" Robinson & Carey.

96

Jan.	2,	1882,	2	to E. G. Felthousen.
Feb.	7,	"	2	" B. M. Lord.
"	13,	"	1	" Ames Iron Works.
"	16,	"	2	" Park & Lacy.
"	24,	"	2	" S. F. Hodge.
"	25,	"	1	" Soldy & McCullock.
April	7,	"	1	" New York Safety Steam Power Co.
"	12,	"	1	" " " " " "
"	28,	"	1	" B. M. Lord.
			25	

3 ½" iron valves at $24.

May	4,	1881,	6	to Babcock & Wilcox.
"	11,	"	2	" " "
"	21,	"	10	" " "
"	26,	"	2	" " "
"	31,	"	12	" " "
July	8,	"	12	" " "
Aug.	2,	"	2	" " "
"	3,	"	8	" " "
"	15,	"	3	" " "
Sept.	6,	"	10	" " "
"	17,	"	6	" " "
"	30,	"	11	" " "
Oct.	6,	"	6	" " "
"	12,	"	7	" " "
"	26,	"	24	" " "
March	6,	1882,	2	" " "
"	8,	"	16	" " "
April	12,	"	3	" " "
"	29,	"	24	" " "
			166	

At $26.

April 5, 1882, 1 to J. F. Rogers.

97

At $28.

June 9, 1881, 2 to Whittier Machine Co.
Nov. 8, " 2 " " " " 1 returned; item 53.
" 17, " 1 " Williams, Wight & Co. " item 65.
April 28, " 2 " Whittier Machine Co.

5

At $32.

June 30, 1881, 2 to James Beggs & Co.
Sept. 20, " 2 " Dickson Mnfg. Co.
Oct. 11, " 1 " Lane & Bodley Co.
Dec. 6, " 1 " Hill, Clark & Co.
Jan. 24, 1882, 1 " " " "
March 20, " 1 " Sumner & Godwin.
April 29, " 2 " W. H. Gallison.

10

At $35.

March 20, 1882, 8 to William Allen & Sons.

4" iron valves at $28.

May 4, 1881, 14 to Babcock & Wilcox.
" 21, " 12 " " "
" 31, " 12 " " "
April 8, " 2 " " "
" 25, " 2 " " "
Aug. 3, " 2 " " "
" 15, " 12 " " "
" 31, " 9 " " "
Sept. 6, " 3 " " "
" 13, " 2 " " "
" 17, " 12 " " "
Oct. 12, " 8 " " "
Nov. 19, " 12 " " "
Dec. 31, " 24 " " "

98

March 8, 1882 12 to Babcock & Wilcox.
April 28, " 1 " " "
" 29, " 24 " " "

163

At $30.

July 2, 1881, 2 to King Iron Works.
April 13, 1882, 1 " National Tube Works.

3

4" at $32.50.

June 15, 1881, 2 to Whittier Machine Co.
" 20, " 6 " " " "
" 28, " 2 " " " "
Nov. 8, " 2 " " " "

12

At $35.

Dec. 9, 1881, 1 to Benton, Faulkner & Bird.

At $38.50.

Jan. 25, 1882, 4 to Globe Iron Works.

At $40.

Aug. 23, 1881, 1 to James Jenks.
Oct. 6, " 1 " Merrimac Woolen Mills.
Dec. 3, " 1 " E. Hodge & Sons.
Feb. 13, 1882, 1 " A. B. Barker.
March 31, " 1 " Ames Iron Works.

5

At $44.

Feb. 14, 1882, 1 to Globe Iron Works. Returned.

5" iron valves sold at $43.75.

Nov. 26, 1881, 2 to Whittier Machine Co.

99 At $46.

Jan. 23, 1882, 3 to Globe Iron Works.

At $55.

July 15, 1881, 2 to W. H. Gallison.
Dec. 6, " 3 " Hill, Clark & Co.

COMPLAINANTS' SCHEDULE 4.

Valves Sold at a Loss, or Less Than 9% Profit, in Period from May 1, 1882, to Apr. 30, 1883.

Sizes.		Prices.	Ret'd costs.	28.81% of price.	Total cost.	No. valves sold.	Profit each.	Loss each.	Gross loss.	
	1¼″	3.00	2.24	.86	3.10	75		.10	7.50	
		3.25		.94	3.18	**111**	.07			
		3.49 37/100		1.01	3.25	**69**	.24+			
		3.50		1.01	3.25	**542**	.25			
Total	1¼″					75				7.50
	1½″	3.50	2.65	1.01	3.66	6		.16	.96	.96
	2½″	11.50	8.50	3.31	11.81	51		.31	15.81	
		13.25		3.82	12.32	**58**	.93			
		13.50		3.89	12.39	**119**	1.11			
Total	2½″					51				15.81
	3 ″	16.00	11.32	4.61	15.93	**89**	.07			
Total brass valves at loss						132				$24.27
Iron.										
	2 ″	6.00	5.70	1.73	7.43	2		1.43	2.86	
		8.00		2.30	8.00	**6**				
		9.00		2.59	8.29	**31**	.71			
Total	2 ″					2				2.86
	2½″	5.00	8.75	1.44	10.19	6		5.19	31.14	
		10.00		2.88	11.63	3		1.63	4.89	
Total	2½″					9				36.03
100	3 ″	16.00	14.00	4.64	18.64	1		2.64	2.64	
		19.50		5.62	19.62	41		.12	4.92	
		20.00		5.76	19.76	**3**	.24			
		21.61½		6.23	20.23	**2**	1.38½			
		22.00		6.33	20.33	**1**	1.67			
		22.50		6.48	20.48	**5**	2.02			
Total	3 ″					42				7.56
	3½″	22.75	18.00	6.55	24.55	1		1.80	1.80	
		24.00		6.91	24.91	2		.91	1.82	
		26.00		7.49	25.49	**2**	.51			
		26.60		7 66	25.66	**5**	.94			
		28.00		8.07	26.07	**21**	1.93			
Total	3½″					3				3.62

	4 ″	28.00	24.00	8.07	32.07	1		4.07	4.07	
		30.00		8.64	32.64	5		2.64	13.20	
		32.50		9.36	33.36	2		.86	1.72	
		33.00		9.51	33.51	2		.51	1.02	
		33.25		9.58	33.58	1		.28	.23	
Total	4 ″					11				20.24
	5 ″	37.50	34.00	10.80	44.80	3		7.30	21.90	
		45.00		12.96	46.96	2		1.96	3.92	
		50.00		14.40	48.40	1	1.60			
		52 50		15.12	49.12	2	3.38			
Total	5 ″					5				25.82
	6 ″	60.00	60.00	17.28	77.28	1		17.28	17.28	17.28
Total iron valves at loss						73				113.41
" brass " " "						132				24.27
Total						205	valves.			137.68

List with Schedule 4.

During the period from May 1, 1882, to April 30, 1883, they sold 1¼ valves—

At $3.

Oct. 31, 1882, 25 to Gaar, Scott & Co.
Feb. 23, 1883, 50 " " " "

75

101

At $3.25.

Jan. 1, 1883, 12 to Atlas Engine Works.
March 2, " 25 " Erie City Iron Works.
" 29, " 50 " Atlas Engine Works.
April 28, " 24 " Erie City Iron Works.

111

At 3.49\frac{17}{100}$.

Nov. 29, 1882, 69 to Ames Iron Works.

NOTE.—This probably arose from error in making chg.

At $3.50.

June 29, 1882, 6 to Prescott, Scott & Co.
July 22, " 15 " Haggert Bros. Mnfg. Co.
Nov. 25, " 6 " Ames Iron Works.
" 27, " 12 " Porter Mnfg. Co.
Dec. 1, " 25 " Noble & Hall.
" 5, " 1 " Erie City Iron Works.

Jan. 5, 1883, 12 " Porter Mnfg. Co.
" 15, " 100 " Northwestern Car Mnfg. Co.
Feb. 12, " 100 " " " " "
Mar. 28, " 100 " " " " "
April 30, " 100 " " " " "
Jan. 19, " 6 " Skinner & Wood.
Feb. 6, " 1 " Ames & Kane.
" 21, " 12 " Porter Mnfg. Co.
Mar. 10, " 1 " " " "
" 30, " 25 " Ames Iron Works.
April 28, " 20 " Haggert Bros. Mnfg. Co.

542

$1\frac{1}{2}$" valves at $3.50.

June 29, 1882, 6 to Prescott, Scott & Co.

102 $2\frac{1}{2}$" valves sold at $11.50.

July 12, 1882, 4 to Burnham, Parry, Williams & Co.
Aug. 17, " 2 " " " " "
Sept. 3, " 4 " " " " "
" 9, " 4 " " " " "
" 21, " 2 " " " " "
" 27, " 6 " " " " "
Oct. 19, " 12 " " " " "
" 31, " 8 " " " " "
Nov. 20, " 12 " " " " "

Returned; item 97.

Jan. 9, 1883, 2 " Burnham, Parry, Williams & Co.
Feb. 21, " 2 " " " " "
March 28, " 3 " " " " "
April 14, " 2 " " " " "

51

At $13.25.

June 16, 1882, 4 to Hinkley Locomotive Works.
" 27, " 10 " " " "
Sept. 2, " 44 " " " "

58

At $13.50.

June 30, 1882, 4 to Canadian Locomotive & Engine Works.
July 18, " 16 " " " " "
Oct. 3, " 10 " " " " "
Nov. 24, " 36 " " " " "
Sept. 27, " 2 " Burnham, Parry, Williams & Co.
Dec. 8, " 2 " Hinkley Locomotive Works.
" 9, " 14 " " " "
Feb. 17, 1883, 17 " " " "
April 30, " 18 " " " "

119

103

3″ valves sold at $16.

May	4, 1882,	4	to Burnham, Parry, Williams & Co.	
"	27, "	2	" " " " "	
July	12, "	7	" " " " "	
Aug.	12, "	4	" " " " "	
Sept.	27, "	2	" " " " "	
			Allowance of $1; item 90.	
Oct.	31, "	4	" Burnham, Parry, Williams & Co., of which 1 was returned; item 290.	
Nov.	15, "	4	" Burnham, Parry, Williams & Co.	
Dec.	23, "	2	" " " " "	
Jan.	9, 1883,	4	" " " " "	
"	31, "	10	" " " " "	
Feb.	21, "	17	" " " " "	
March	3, "	4	" " " " "	
"	8, "	3	" " " " "	
"	10, "	14	" " " " "	
"	28, "	4	" " " " "	
April	14, "	3	" " " " "	
"	28, "	2	" " " " "	
		89		

2″ iron valves sold at $6.

Jan.	20, 1883,	2	to W. H. Jenks.

At $8.

April	28, 1883,	6	to Erie City Iron Works.

At $9.

July	3, 1882,	6	to Park & Lacy.
"	13, "	2	" Kendall & Roberts.
"	14, "	2	" C. H. Delameter & Co. Returned; item 329.
Oct.	25, "	1	" James Rees.
"	31, "	1	" Ripley & Kimball.
Nov.	24, "	1	" Lidgerwood Mnfg. Co.

104

Dec.	1, 1882,	6	to Noble & Hall.
"	21, "	1	" T. M. Nagle.
Jan.	1, 1883,	6	" Atlas Engine Works. 5 returned; item 310.
"	3, "	3	" Mayer & Co. 2 returned; item 321.
"	5, "	5	" T. M. Nagle.
"	12, "	4	" Wickes Bros.
Feb.	3, "	1	" R. M. Vervalin.
"	23, "	1	" Farnham's Brass Works.
		31	

2½" iron valves sold at $5.

Jan. 1, 1883, 6 to Atlas Engine Works.

At $10.

Dec. 1, 1882, 3 to Noble & Hall.

3½" iron valves sold at $16.

June 27, 1882, 1 to New York Safety Steam Power Co.

At $19.50.

June 12, 1882, 1 to Benton, Faulkner & Bird.
July 3, " 6 " Park & Lacy.
July 10, " 1 " C. H. Delameter.
" 12, " 2 " Duplex Boiler Co.
" 14, " 6 " C. H. Delameter & Co.
" " " 6 " William Allan & Son.
" 28, " 2 " " " "
Oct. 2, " 3 " James B. Clough & Son.
" " " 2 " William Allan & Son.
" " " 1 " Ripley & Kimball.
Nov. 9, " 3 " William Allan & Co.
Feb. 27, " 2 " Babcock & Wilcox Co. Returned; item 308.
March 2, " 6 " Erie City Iron Works.

105

April 25, 1882, 1 to National Tube Works.
May 26, " 1 " Duplex Safety Boiler Co.
June 3, " 1 " Atwood & McGaffrey. Returned; item 167.

41

At $20.

March 16, 1883, 3 to E. Hodge & Co.

At $21.61½.

July 26, 1882, 2 to C. E. Ashcroft.

At $22.

Jan. 5, 1883, 1 to Whittier Machine Co.

At $22.50.

Dec. 8, 1882, 3 to Wickes Bros.
March 31, 1883, 2 " John Taylor & Bro.

3½" iron valves sold at $22.75.

June 12, 1882, 1 to D. M. Dillon.

At $24.

Oct. 2, 1882, 1 to James B. Clough & Son.
" 31, " 1 " Ripley & Kimball.

At $26.

July 28, 1882, 2 to King Iron Works.

At $26.60.

July 26, 1882, 5 to C. E. Ashcroft.

At $28.

May 26, 1882, 2 to Whittier Machine Co.
" 27, " 3 " Benton, Faulkner & Bird.
June 8, " 2 " Whittier Machine Co.
Aug. 2, " 1 " " " "
" 12, " 1 " Erie City Iron Works.
" 14, " 5 " Whittier Machine Co.

106

Sept. 27, 1882, 1 to Ashcroft & Barker Mnfg. Co.
Never paid for; item 175.
Oct. 21, " 1 " Erie City Iron Works.
Nov. 9, " 3 " Whittier Machine Co.
Feb. 27, 1883, 3 " " " "

21

Of 4″ iron valves they sold at $28,

Oct. 24, 1882, 1 to Babcock & Wilcox.

At $30.

May 17, 1882, 1 to Duplex Safety Boiler Co.
" 27, " 1 " " " " "
Oct. 2, " 1 " James B. Clough & Son.
" 27, " 1 " National Tube Works.
" 31, " 1 " Ripley & Kimball.

5

At $32.50.

Dec. 8, 1882, 2 to Whittier Machine Co.

At $33.

Dec. 8, 1882, 2 to Wickes Bros.

At $33.25.

July 26, 1882, 1 to C. E. Ashcroft.

5″ iron valves sold at $37.50.

June 8, 1882, 2 to Duplex Safety Boiler Co.
April 20, 1883, 1 " J. B. Clough & Son.

At $45.

July 21, 1882, 2 to Babcock & Wilcox.

At $50.

Feb. 27, 1883, 1 to Wahlampsook Paper Co.
Billed at $87.50; allowance of $37.50 by item 150.

107 At $52.50.

Aug. 12, 1882, 2 to Erie City Iron Works.

6″ iron valves sold at $60.

March 8, 1883, 1 to Globe Iron Works.

COMPLAINANTS' SCHEDULE 5.

Valves Sold at Loss, or Less than 10% Profit, from May 1, 1883, to Sept. 25, 1883.

Sizes.		Prices.	Ret'd costs.	30.91% of price.	Total cost.	No. valves sold.	Profit each.	Loss each.	Gross loss.	
	1¼″	3.25	2.00	1.00	3.00	84	.25			
	1½″	3.40	2.43	1.05	3.48	2		.08	.16	.16
	2½″	11.50	8.05	3.55	11.60	6		.10	.60	
		13.00		4.02	12.07	4	.93			
		13.50		4.17	12.22	58	1.28			
Total	2½″					6				.60
	3 ″	16.00	10.54	4.95	15.49	80	.51			
		17.25		5.33	15.87	1	1.38			
Total brass valves at loss						8				.76
Iron.										
	3 ″	19.50	13.00	6.03	19.03	26	.47			
		21.11½		6.53	19.53	2	1.58½			
	4 ″	30.00	22.00	9.27	31.27	7		1.27	8.89	
		33.00		10.20	32.20	2	.80			
		35.00		10.82	32.82	5	2.18			
Total	4 ″					7				8.89
	5 ″	40.50	30.00	12.52	45.52	1		2.02	2.02	
		47.25		14.60	44.60	1	2.65			
		37.50		11.59	41.59	1		4.09	4.09	
Total	5 ″					2				6.11
Total iron valves at loss						9				15.00
" brass " " "						8				.76
Total						17 valves.				15.76

108 *List with Schedule* 5.

Defendant sold in the period from May 1, 1883, to Sept. 25, 1883,

1¼″ valves at $3.25.

July 20, 1883, 24 to Erie City Iron Works.
Aug. 15, " 60 " Atlas Engine Works.

1½″ valves at $3.40.

June 30, 1883, 2 to N. O. Nelson Mnfg. Co.

(On this and other bills there were allowed by item 151 a discount of over 10%.)

2½″ valves at $11.50.

May 29, 1883, 4 to Burnham, Parry, Williams & Co.
July 13, " 2 " " " " "

At $13.

June 29, 1883, 4 to Burnham, Parry, Williams & Co.

At $13.50.

May 5, 1883, 12 to Canadian Locomotive Works.
Aug. 28, " 12 " " " "
May 31, " 20 " Hinkley Locomotive Works.
June 29, " 2 " " " "
Aug. 27, " 1 " " " " Returned. Item 165.

58

3″ valves sold at $16.

May 5, 1883, 6 to Burnham, Parry, Williams & Co.
" 29, " 4 " " " " "
June 16, " 6 " " " " "
" 29, " 6 " " " " "
July 4, " 4 " " " " "
" 18, " 8 " " " " "

109

Aug. 11, 1883, 22 to Burnham, Parry, Williams & Co.
" 22, " 4 " " " " "
" 31, " 12 " " " " "
Sept. 19, " 8 " " " " "

80

At $17.25.

May 5, 1883, 1 to Hunnecutt & Billingrath.

3″ iron valves sold at $19.50.

May 10, 1883, 1 to National Tube Works.
" 11, " 2 " Atwood & McCaffrey.
" 16, " 1 " North Star Iron Works.

" 21, " 1 " W. H. Perry.
" 26, " 1 " King Iron Works.
" 31, " 1 " D. H. Jerome & Co.
June 7, " 3 " William Allan & Son.
" 8, " 2 " Michigan Iron Works.
" 22, " 2 " James Clements & Sons.
" 26, " 1 " Eaton, Cole & Burnham.
July 16, " 2 " J. J. Howden.
" 18, " 1 " William Allan & Sons.
" 20, " 2 " James Clements & Sons.
Aug. 11, " 4 " John Taylor & Bro.
Sept. 6, " 1 " Buckeye Bridge & Boiler Works.
" 12, " 1 " King Iron Works.

26

At $21.11½.

May 29, 1883, 2 to A. Leitell.

4" iron valves sold at $30.

May 16, 1883, 1 to James Clements & Sons.
" 31, " 1 " " " "
" 31, " 1 " D. H. Jerome.

110

June 19, 1883, 2 to Ripley & Kimball.
July 16, " 1 " J. J. Howden.
" 20, " 1 " James Clements & Sons.

7

At $33.

May 31, 1883, 1 to A. Harvey & Sons.
June 8, " 1 " Michigan Iron Works.

At $35.

May 31, 1883, 5 to H. S. Russell.

5" iron valves sold at $37.50.

May 19, 1883, 1 to King Iron Works.

At $40.50.

June 5, 1883, 1 to John Taylor & Bro.

At $47.25.

May 9, 1883, 1 to Wilson & Howdrie.

* * * * * * *

111 *Defendants' Objections to Master's Second Draft Report.* (*Filed March* 18, 1889.)

To the master's second draft report in the accounting proceedings before him in the above-entitled causes the defendants respectfully submit the following objections:

* * * * * * *

IV.

Finding 8. The disallowance of item 7 of finding 8 is objected — by the defendants.

V.

To the master's finding that "all the different valves put upon the market by the complainants" contained Richardson's improvement of 1866 the defendants object.

VI.

Amended findings 13 and 14. That the master has not made sufficient allowances for the expenses incurred by the defendants in their manufacture of the Crosby valves, in that he has disallowed the loss and expense to them arising from the modification and reconstruction of certain kinds of said valves, and respectfully
112 refer the master to the defendants' reasons for their objection to his disallowance of item 7 of finding 8, on pages 4, *et seq.* of his report.

And hereupon the defendants respectfully say the said amended findings 13 and 14 for profits are incorrect, and object thereto.

VII.

Amended finding 15. The defendants respectfully object to amended finding 15, and for their reasons therefor refer to those expressed in their objection to finding 15 in the master's first draft report.

VIII.

The defendants respectfully request the master to submit with his report the testimony taken before him in the accounting proceedings herein and printed under the title "proceedings before the master;" also the exhibits referred to in the said testimony.

(Master's note 98.—In view of the requests for reports of evidence which have been made by the parties respectively in their objections to my first and second draft reports, I have determined to report the whole evidence before me to the court, excepting only such schedules and exhibits as the parties may agree may be omitted. I regret the necessity which compels me to do this, but I am satisfied that no partial report of the evidence would enable the court to pass upon the objections which have been made to

these draft reports if these objections should be incorporated in exceptions to my final report. Should it appear, upon the filing of exceptions to my final report, that the objections taken to my draft reports are to a large extent abandoned, I respectfully recommend that the exceptions and evidence reported be referred to me with directions to strike out from the evidence all that can be properly stricken out, that the court may be relieved from a consideration of evidence which may be immaterial to a consideration of the exceptions. Upon the objections taken, I am of the opinion that substantially the whole evidence must be before the court for a proper consideration of the objections, and I cannot in advance presume that any of the objections will be abandoned.)

B. F. THURSTON,
J. H. MILLETT,
Defendants' Counsel.

Respectfully submitted as a third draft report.

JOHN G. STETSON, *Master.*

113 May 15, 1879, I submitted the foregoing as a third draft report.

As to the first cause, No. 1184, the complainants make no further objections or requests for findings, and the defendants present again the objections which they submitted to my second draft report, but make no new objections or requests. The proceedings before me in cause No. 1184 are therefore closed, except that it remains to be determined what evidence, schedules, and exhibits are to be returned to the court with my final report. Before making this final report I will submit to counsel suggestions on this subject with a view to obtaining the consent of both parties to the omission of certain voluminous schedules and exhibits; but, except as the parties may consent, I will report the whole evidence as heretofore determined in master's note 98.

In the second cause, No. 1199, the complainants file objections to my third draft report and make requests for further findings of facts.

I have carefully considered these objections and requests and have made upon them notes showing my action thereon. The papers filed by the parties respectively are as follows:

Complainants' Response to Master's Third Draft Report in Cause No. 1184. (*Filed May* 22, 1889.)

In the view taken by the complainants in cause No. 1184 it does not seem necessary to make any further objections or requests for findings.

By solicitor, THOS. WM. CLARKE.

* * * * * * *

114 *Defendants' Objections to Master's Third Draft Report.* (*Filed June* 1, 1889.)

To the master's third draft report in the above-entitled suits the defendants submit for their objections thereto the same objections which they submitted to the master's second draft report therein, and respectfully refer him to them.

B. F. THURSTON,
J. H. MILLETT,
Defendants' Counsel.

Respectfully submitted as a fourth draft report.

JOHN G. STETSON, *Master.*

June 19, 1889, I submitted the foregoing as a fourth draft report Subsequently the complainants and the defendants, each by their counsel, informed me that they would file no further objections or requests, and that they renewed the objections and requests which they had heretofore taken and made to my former draft re-
115 ports. I have already considered these objections and requests and I take no further action upon them.

July 12, 1889, counsel for both parties appeared before me, at my request, to consider what papers, which I have referred to in my report as annexed thereto, and what parts of the evidence before me might be omitted from the evidence returned with my report, and thereupon counsel for both parties agreed to the omission of the schedules filed with defendants' accounts showing details of sales of valves from Feb. 15, 1879, to Jan. 31, 1885, and the depositions of James M. Clark and Stephen Thatcher, and stipulated that said Thatcher testified that the arithmetical calculations of complainants' analysis of defendants' accounts had been made and proved by him and were correct, except certain clerical and typographical errors which have been corrected in complainants' analysis as returned by me, and that said Clark testified that he had compiled the first two columns of the schedules of sales in complainants' charge, containing prices and numbers of valves as corrected and returned by me, and that they were correctly compiled from the detailed schedules of sales as corrected by deducting specific valves returned, etc., contained in certain lists produced by Mr. Eager in answer to Int. 3, page 302, of the evidence returned by me, which lists were marked for identification page 311. Counsel consented that these lists may be omitted in my return of the evidence before me.

Counsel further stipulated that, except as set forth in my report, the valves enumerated in the schedules in complainants' modified charge, as sold "at or below" given prices, were sold at the prices named, and that to this extent the said schedules may be taken to represent the quantities of valves at the prices named, derivable from the detailed schedules which are omitted from my report by consent, as before stated.

Counsel also agreed that the following schedules and exhibits may be omitted in my return of the evidence before me, namely, general expense account (see evidence, page 310); Moore list (Int. 3) and Moore list (Int. 4) (evidence, page 350); certificates of condition of defendant corporation for the years 1876 to 1884 (evidence, page 371), and memorandum of corrections in Schedules 16*a*, 16*b*, 16*c*, and 16*d* (evidence, page 379), the same being corrections
116 in the lists produced by Mr. Eager, also omitted (evidence, page 302 and page 311, where these lists are called accounts of valves returned, Nos. 1, 2, 3, and 4).

I return with my report all the evidence before me, except what is omitted by consent of the parties, as above set forth, and except that to which I was referred which is contained in the record of these cases at rules. This latter evidence is already before the court in these cases, and I deem it unnecessary to return it with this report.

These cases, Nos. 1184 and 1199, were originally heard together before the circuit court and were transferred to the Supreme Court upon appeal upon the same record of evidence. Separate mandates were received from the Supreme Court and separate orders of reference to me as master were made, but the cases have been heard together before me. I have distinguished between them where it has been necessary to do so. It is not practicable for me to make separate reports, and I therefore file this report in each case.

Respectfully submitted.

JOHN G. STETSON, *Master.*

117 No. 1184.

Defendants' Account.

In compliance with the order of the master in the above cause, the defendants herewith submit to him their account of the profits made by them in the manufacture, sale, and use of the Crosby valves during the interval from Feb. 15, 1879, to Sept. 25, 1883, at which latter date the letters patent to George W. Richardson of Sept. 25, 1866, expired, the same being the period as to which they are required to account.

The statements below exhibit the number, class, size, and prices of all the valves made and sold by them during the period given, as taken from the sales books, subdivided into shorter periods corresponding to the financial year of the defendants' business.

The costs of the several classes and sizes of such valves and the expenses of their construction and the carrying on the business of the defendants during the period named, both as they apply specially and generally to said valves and the departments of their manufacturing appertaining to said valves, have been closely and accurately obtained, it is believed, and are moderate and just.

I.

Memorandum of Safety-Valves Made and Sold from Feb. 15, 1879, to Sept. 25, 1883, Showing Classes, Sizes, and Prices at which They were Sold.

(1.)

From Feb. 15, 1879, to May 1, 1880.

1	1	in.	brass safety-valves	6 00	(1)
2,209	1¼	"	do.	10,678 55	(2)
82	1½	"	do.	603 25	(3)
53	2	"	do.	624 75	(4)
37	2¼	"	do.	656 00	(5)
643	2½	"	do.	13,022 00	(6)
121	3	"	do.	3,618 50	(7)
10	2	"	iron safety-valves	130 50	(8)
9	2½	"	do.	222 50	(9)
16	3	"	do.	534 85	(10)
4	3½	"	do.	141 00	(11)
2	4	"	do.	80 00	(12)
3,187				30,317 90	(13)
118					

(2.)

From May 1, 1880, to May 1, 1881.

100	1	in.	brass safety-valves	419 45	(14)
2,347	1¼	"	do.	10,042 50	(15)
186	1½	"	do.	1,335 50	(16)
129	2	"	do.	1,376 25	(17)
71	2¼	"	do.	1,092 00	(18)
720	2½	"	do.	14,007 25	(19)
193	3	"	do.	5,540 80	(20)
18	2	"	iron valves	226 60	(21)
44	2½	"	do.	869 00	(22)
37	3	"	do.	1,128 00	(23)
19	3½	"	do.	608 00	(24)
31	4	"	do.	1,084 50	(25)
3,895				37,729 85	(26)

(3.)

From May 1, 1881, to May 1, 1882.

492	1	in.	brass safety-valves	1,987 80	(27)
3,133	1¼	"	do.	12,603 30	(28)
425	1½	"	do.	2,685 45	(29)
225	2	"	do.	2,202 05	(30)
41	2¼	"	do.	620 50	(31)
1,177	2½	"	do.	21,226 75	(32)
373	3	"	do.	7,742 75	(33)

92	2	"	iron valves	1,053 50	(34)
2	2¼	"	do.	30 50	(35)
105	2½	"	do.	1,953 50	(36)
127	3	"	do.	3,255 50	(37)
214	3½	"	do.	5,342 00	(38)
198	4	"	do.	5,851 00	(39)
9	5	"	do.	465 50	(40)
6,613				67,020 10	(41)

119

(4.)

From May 1, 1882, to May 1, 1883.

1	¾	in.	brass safety-valves	3 00	(42)
779	1	"	do.	2,926 30	(43)
3,672	1¼	"	do.	14,371 65	(44)
709	1½	"	do.	4,339 75	(45)
212	2	"	do.	2,065 50	(46)
83	2¼	"	do.	1,299 00	(47)
1,001	2½	"	do.	17,412 50	(48)
280	3	"	do.	6,217 00	(49)
186	2	"	iron valves	2,119 00	(50)
232	2½	"	do.	4,159 75	(51)
156	3	"	do.	3,786 23	(52)
47	3½	"	do.	1,391 50	(53)
27	4	"	do.	1,062 25	(54)
10	5	"	do.	525 00	(55)
1	6	"	do.	60 00	(56)
7,396				61,738 43	(57)

(5.)

From May 1, 1883, to Sept. 25, 1883.

3	¾	in.	brass safety-valves	11 80	(58)
364	1	"	do.	1,418 00	(59)
2,035	1¼	"	do.	7,734 22	(60)
342	1½	"	do.	1,976 30	(61)
68	2	"	do.	684 50	(62)
60	2¼	"	do.	843 00	(63)
278	2½	"	do.	5,254 50	(64)
110	3	"	do.	2,090 50	(65)
100	2	"	iron safety-valves	1,096 65	(66)
85	2½	"	do.	1,481 30	(67)
77	3	"	do.	1,736 48	(68)
8	3½	"	do.	239 00	(69)
24	4	"	do.	846 00	(70)
6	5	"	do.	281 75	(71)
3,560				25,694 00	(72)

120 Valves sold for cash from Feb. 15, 1879, to Sept. 25, 1883.

1879–'80.				
3	1¼	in. brass safety-valves	19 75	(73)
1880–'81.				
2	1¼	" do.	10 00	(74)
1	1½	" do.	10 00	(75)
1881–'2.				
7	1¼	" do.	38 00	(76)
2	1½	" do.	15 00	(77)
1882–'3.				
4	1	" do.	24 00	(78)
7	1¼	" do.	46 75	(79)
1	2	"	12 00	(80)
1	2½	"	15 00	(81)
To Sept. 25th.				
3	1	in.	16 50	(82)
4	1¼	"	22 00	(83)
1	2½	"	20 00	(84)
36			249 00	(85)

Summary of sales of safety-valves made and sold from Feb. 15, 1879, to Sept. 15, 1883.

3,187	From Feb. 15, 1879, to May 1, 1880	30,317 90	(86)
3,895	From May 1, 1880, to May 1, 1881	37,729 85	(87)
6,613	From May 1, 1881, to May 1, 1882	67,020 10	(88)
7,396	From May 1, 1882, to May 1, 1883	61,738 43	(89)
3,560	From May 1, 1883, to Sept. 25, 1883	25,694 00	(90)
36	Cash sales during above dates	249 00	(91)
24,687		222,749 28	(92)

II.

Memorandum of costs of the several classes and sizes of safety-valves made and sold by the defendants during the period from Feb. 15, 1879, to Sept. 25, 1883, inclusive, stated according to the financial year of their business.

121 (1.)

From Feb. 15, 1879, to May 1, 1880.

1	1	in. brass safety-valves	2 50	2 50	(93)
2,209	1¼	" do.	2 50	5,522 50	(94)
82	1½	" do.	3 38	277 16	(95)
53	2	" do.	5 13	271 89	(96)
37	2¼	" do.	8 50	314 50	(97)
643	2½	" do.	10 11	6,500 73	(98)
121	3	" do.	14 00	1,694 00	(99)
10	2	" iron safety-valves	7 87	78 70	(101)
9	2½	" do.	12 50	112 50	(102)

16	3	"	do.	17 00	272 00	(103)
4	3½	"	do.	23 00	92 00	(104)
2	4	"	do.	30 00	60 00	(105)
3,187					15,198 48	(106)

(2.)

From May 1, 1880, to May 1, 1881.

100	1	in.	brass safety-valves	2 04	204 00	(107)
2,347	1¼	"	do.	2 43	5,703 21	(108)
186	1½	"	do.	3 13	582 18	(109)
129	2	"	do.	4 75	612 75	(110)
71	2¼	"	do.	7 87	558 77	(111)
720	2½	"	do.	9 62	6,926 40	(112)
193	3	"	do.	13 15	2,537 95	(113)
18	2	"	iron safety-valves	7 00	126 00	(114)
		"	do.	11 25		(115)
44	2½	"	do.	11 25	495 00	(116)
37	3	"	do.	16 00	592 00	(117)
19	3½	"	do.	21 50	408 50	(118)
31	4	"	do.	28 00	868 00	(119)
3,895					19,614 76	(120)
122						

(3.)

From May 1, 1881, to May 1, 1882.

492	1	in.	brass safety-valves	1 89	929. 88	(121)
3,133	1¼	"	do.	2 34	7,331 22	(122)
425	1½	"	do.	2 90	1,232 50	(123)
225	2	"	do.	4 25	956 25	(124)
41	2¼	"	do.	7 53	308 73	(125)
1,177	2½	"	do.	9 00	10,593 00	(126)
373	3	"	do.	12 20	4,550 60	(127)
92	2	"	iron safety-valves	6 50	598 00	(128)
2	2¼	"	do.	9 50	19 00	(129)
105	2½	"	do.	9 50	997 50	(130)
127	3	"	do.	15 00	1,905 00	(131)
214	3½	"	do.	20 00	4,280 00	(132)
198	4	"	do.	26 00	5,148 00	(133)
9	5	"	do.	36 00	324 00	(134)
6,613					39,173 68	(135)

(4.)

From May 1, 1882, to May 1, 1883.

1	¾	in.	brass safety-valves		3 00	(136)
779	1	"	do.	1 67	1,300 93	(137)
3,672	1¼	"	do.	2 24	8,225 28	(138)
709	1½	"	do.	2 65	1,878 85	(139)

212	2	"	do.	3	84	814 08 (140)
83	2½	"	do.	7	05	585 15 (141)
1,001	2½	"	do.	8	50	8,508 50 (142)
280	3	"	do.	11	32	3,169 60 (143)
186	2	"	iron safety-valves	5	70	1,060 20 (144)
232	2½	"	do.	8	75	2,030 00 (145)
156	3	"	do.	14	00	2,184 00 (146)
47	3½	"	do.	18	00	846 00 (147)
27	4	"	do.	24	00	648 00 (148)
10	5	"	do.	34	00	340 00 (149)
1	6	"	do.	60	00	60 00 (150)
7,396						31,653 59 (151)

123

(5.)

From May 1, 1883, to Sept. 25, 1883.

3	¾	in.	brass safety-valves	1	54	4 62 (152)
364	1	"	do.	1	54	560 56 (153)
2,035	1¼	"	do.	2	00	4,070 00 (154)
342	1½	"	do.	2	43	831 06 (155)
68	2	"	do.	3	51	238 68 (156)
60	2½	"	do.	6	75	405 00 (157)
278	2½	"	do.	8	05	2,237 90 (158)
110	3	"	do.	10	54	1,159 40 (159)
100	2	"	iron safety-valves	5	00	500 00 (160)
85	2½	"	do.	8	00	680 00 (161)
77	3	"	do.	13	00	1,001 00 (162)
8	3½	"	do.	17	00	136 00 (163)
24	4	"	do.	22	00	528 00 (164)
6	5	"	do.	30	00	180 00 (165)
3,560						12,532 22 (166)

Cash Sales of Valves from Feb. 15, 1879, to Sept. 25, 1883.

Costs.

1879–'80.						
3	1¼	in.	brass	2	50	7 50 (167)
1880–'81.						
2	1¼	"	do.	2	43	4 86 (168)
1	1½	"	do.	3	13	3 13 (169)
1881–'82.						
7	1¼	"	do.	2	34	16 38 (170)
2	1½	"	do.	2	90	5 80 (171)
1882–'83.						
4	1	"	do.	1	67	6 68 (172)
7	1¼	"	do.	2	24	15 68 (173)
1	2	"	do.	3	84	3 84 (174)
1	2½	"	do.	8	50	8 50 (175)

To Sept. 25.					
3	1	"	do.	11 54	4 62 (176)
4	1¼	"	do.	2 00	8 00 (177)
1	2½	"	do.	8 05	8 05 (178)
36					93 04 (179)

124 *Summary of Cost of Safety-Valves.*

No.			
3187	From Feb. 15, 1879, to May 1, 1880	15,198 48	(180)
3895	" May 1, 1880, to May 1, 1881	19,614 76	(181)
6613	" May 1, 1881, to May 1, 1882	39,173 68	(182)
7396	" May 1, 1882, to May 1, 1883	31,653 59	(183)
3560	" May 1, 1883, to Sept. 25, 1883	12,532 22	(184)
36	" Cash sales during above dates, cost	93 04	(185)
24687		118,265 77	(186)

III.

Statement giving the proportion of the general expenses of transacting the defendants' business during the period named, applicable to the manufacture and sale of said valves, subdivided in accordance with the business year.

Also deductions for losses made in the valve business during the same time.

1. *General Expenses.*

34.32 %	from Feb'y 15, 1879, to May 1, 1880	7,422 30	(187)
36.32 %	" May 1, 1880, to May 1, 1881	10,026 27	(188)
42.70 %	" May 1, 1881, to May 1, 1882	12,835 28	(189)
34.31 %	" May 1, 1882, to May 1, 1883	14,763 46	(190)
36.63 %	" May 1, 1883, to Sept. 25, 1883	6,821 49	(191)

2. *Losses.*

From bad debts	659 75	(192)
From valves returned	5,776 75	(193)
	58,305 30	(194)

IV.

Statement of expenses incurred by the defendants which are special to the manufacture and sale of the safety-valves during the period above named and the costs of parts employed upon the
125 valves, but not constituting any portion of the valve proper, as claimed under the Richardson patent of 1866, but are charged in the selling price of the same. These special expenses are not included in the general expenses above given.

1. Cost of patterns made for valves and parts	2,924 23	(195)
2. One-half of the salary of Geo. H. Crosby, the inventor of the Crosby valve	6,354 17	(196)
One-half of the salary and expenses of Geo. E. Boyden, Jan'y 1, '83, to Sept. 25, '83	1,096 81	(197)

3. Nickel-plating valves		16 00	(198)
4. Locks for safety-valves		160 00	(199)
5. 247 levers for loco. valves, { 165 2½ in. @ 47c. / 83 3½ " @ 78c. }		141 51	(200)
6. 165 perforated caps, $1.50		247 50	(201)
213 lock-up attachments		163 68	(202)
7. Cost of modification and reconstruction of iron valves in 1882, '83, prior to Sept. 25, 1883		1,978 84	(203)
8. Commissions paid for sales of valves prior to Sept. 25, 1883; also extra discounts during same time on price of valves sold		2,345 76	(204)
		15,428 50	(205)

Summary.

Gross sales from Feb. 16, 1879, to Sept. 25, 1883, Statement I		222,749 28	(206)
Cost of valves during same period, Statement II	118,265 77		(207)
General expenses during same time, and losses, Statement III	58,305 30		(208)
Special expenses during same time, Statement IV	15,428 50		(209)
Proportion of interest on loan paid, 1879 to 1882, inclusive, av. 39.8 per cent.	340 07		(210)
126 Amount due to Meady's patent lever	318 45		(211)
Amount paid in litigation prior to Sept. 25, 1883, concerning valves	4,994 83		(212)
		197,652 92	(213)
		25,096 36	(214)

Statement apportioning the total amount of profits derived from the manufacture and sale of Crosby valves among the constituents of the Crosby valve in order to ascertain the amount of profit which has accrued to the complainants for and on account of the employment of the Richardson patent of 1866, in the Crosby valve, in case it shall be finally determined that such profit is due to the complainants, and not to the Waterman expired patent.

The Crosby valve contains the following constituents, which are entitled to a share of profits derived from the manufacture and sale of the Crosby valve; and while the defendants may be unable to determine now the actual distribution of such profits, they believe that the proportions given represent substantially the proper ratio.

1. The inventions and improvements known to the art prior to the date of the Richardson patent of 1866, as described in the patents of Ritchie in 1848 and Webster in 1857, fifty per cent (50%).

2. The inventions and improvements as described and shown in

the patents of George H. Crosby, forty per cent. (40%); and here the defendants say that so radical were the changes in the construction of safety-valves brought about by the Crosby invention, and due to that alone, that were the safety-valves above given made in accordance with the description of the Richardson patent of 1866 there would be no profits at all to be apportioned, as all such profits would be consumed in the additional cost of the making the Richardson valves, and will be so claimed and shown, if it shall be considered that nothing is due to the prior art as herein stated.

3. The invention and improvements shown and described in the Waterman reissued patent or in the Richardson patent, whichever shall be entitled to precedence of claim, ten per cent. (10%).

These defendants do not admit that there is any profit that
127 is due to the complainants for or on account of the employment of the Richardson patent of 1866; but they insist and claim that all rights which the complainants might have had to said share of profits has been waived by George W. Richardson & Co. by the procurement of the reissue of the Waterman patent, and the effect of such reissue was, after such reissue, to relegate the invention set forth therein to the public domain—the same have expired in 1874, prior to the making of the Crosby valves and the Crosby patents—and to work a license to these defendants and to all others to make use of the invention set forth in said Waterman reissue patent; and that such invention is the same invention as that set forth in the Richardson patent of 1866.

Wherefore the defendants claim that the master should adjudge that no profits or damages have accrued to the complainants.

CROSBY STEAM GAGE AND VALVE COMPANY,
By GEO. H. EAGER, *Treasurer.*

Then personally appeared the above-named George H. Eager and said that he is treasurer of the Crosby Steam Gage and Valve Company and subscribed the above account, and that the exhibition therein of sales and costs of safety-valves are just and correct to the best of his knowledge and belief.

Before me—

[SEAL.] DUDLEY P. BAILEY,
Notary Public.

128 Circuit Court of the United States, District of Massachusetts.
In Equity.

CONSOLIDATED SAFETY VALVE COMPANY
v.
CROSBY STEAM GAGE AND VALVE COMPANY. } Nos. 1184 and 1199.

Complainants' Analysis of Account and Modified Charge in Profits and Damages in Each of said Two Cases. J. G. S., Master. (*Filed with the Master Sept.* 1, 1885.)

* * * * * * *

129 *Complainants' Modified Charge.* (*Filed with the Master June 22, 1886.*)

In the above-entitled cause, in view of the evidence presented, the charge in profits and damages is modified as follows:

Complainants' Charge in Profits.

Complainants say that the number of valves sold by defendants in each year or period of the accounting of the several sizes were equal to the number borne on their sales account, less the number returned and less the number sent out as samples and specimens and lost, which are carried by them in the profit and loss account and for which they claim allowance.

They further say that the cost of such valves as were sold in labor, material, general expenses, special expenses, interest on capital, and all other proper charges going to the expense of putting the goods in the hands of customers did not exceed the lowest price at which valves of the same size were sold or charged as sold and then returned in the same year, or at which valves of larger or more expensive sizes were sold or charged and returned in the same year, or than the lowest prices at which the same or larger valves were sold or charged in more expensive years, and that defendants are concluded, by their selling prices, from claiming or being allowed a higher cost than said highest prices, and that the following schedules of profits and of valves sold at or below cost set forth the number of valves and the profits, calculated valve by valve, at each selling price on such basis.

And that during the period from Feb. 15, 1879, to April 30, 1880, both inclusive, defendants made and sold—

130

2,011	1″ and 1¼″	brass	valves	at a profit of	$1,835 05
192		"	"	" no profit.	
58	1½″	"	"	" a profit of	187 25
25	"	"	"	" no profit.	
49	2″	"	"	" a profit of	201 75
1	2″	"	"	" no profit.	
61	2¼″	"	"	" a profit of	432 90
555	2½″	"	"	" a profit of	4,299 50
61	2½″	"	"	" no profit.	
94	3″	"	"	" a profit of	1,269 30
20	3″	"	"	" no profit.	
10	2″	iron	"	" a profit of	30 50
3	2½″	"	"	" a profit of	37 50
3	2½″	"	"	" no profit.	
14	3″	"	"	" a profit of	113 35
3	3½″	"	"	" a profit of	15 00

Net number of valves, 3,160.

	Making the profits for the first period	$8,422 10
	On which the items of "account of valves returned, etc., No. 1," (3) $30, (6) $30, (7) $15, (19) $25, (73) $32.50, and no others can properly be credited	132 50
	Net profits for period No. 1	$8,289 60

And that during the period from May 1, 1880, to April 30, 1881, both inclusive, defendants made and sold—

38	1″ brass valves at a profit of	$33 70
62	1″ " " " no profit.	
2,207	1¼″ " " " a profit of	1,831 00
124	1¼″ " " " no profit.	
122	1½″ " " " a profit of	253 25
35	1½″ " " " no profit.	
109	2″ " " " a profit of	345 35
19	2″ " " " no profit.	
64	2½″ " " " a profit of	151 00
662	2½″ " " " a profit of	4,439 50
61	2½″ " " " no profit.	
131		
154	3″ brass valves at a profit of	1,939 05
36	3″ " " " no profit.	
14	2″ " " " a profit of	37 00
1	2″ " " " no profit.	
40	2½″ " " " a profit of	215 00
6	2½″ " " " no profit.	
28	3″ " " " a profit of	400 25
10	3″ " " " no profit.	
14	3½″ " " " a profit of	86 00
1	3½″ " " " no profit.	
31	4″ " " " a profit of	240 50
2	4″ " " " no profit.	
3,840		
	Making the profits for the second period	$9,971 60
	On which the items of account, valves returned, etc., (15) $30, (16) $3, (21) $2.50, (37) $10.50, (280) $34.50, and no others can properly be credited	80 50
	Net profits for period No. 2	$9,891 10

And that during the period from May 1, 1881, to April 30, 1882, both inclusive, defendants made and sold—

459	1″ brass valves at a profit of	$239 80
47	1″ " " " no profit.	
3,034	1¼″ " " " a profit of	3,488 25
50	1¼″ " " " no profit.	

372	1½"	" " " a profit of	1,075 95
50	1½"	" " " no profit.	
192	2"	" " " a profit of	591 00
31	2"	" " " no profit.	
37	2½"	" " " a profit of	104 50
1	2½"	" " " no profit.	
960	2½"	" " " a profit of	5,742 00
200	2½"	" " " no profit.	
147	3"	" " " a profit of	1,779 75
224	3"	" " " no profit.	
132			
75	2" iron	valves at a profit of	$221 00
2	2"	" " " no profit.	
62	2½"	" " " a profit of	339 50
22	2½"	" " " no profit.	
118	3"	" " " a profit of	1,019 25
26	3½"	" " " a profit of	206 00
187	3½"	" " " no profit.	
31	4"	" " " a profit of	291 00
166	4"	" " " no profit.	
7	5"	" " " a profit of	71 75
2	5"	" " " no profit.	
6,502			

Making the profits for the third period $15,169 75

On which the items of account of valves returned, etc., (30 to 33) $26, (38) $11.70, (42, 43) $8, (47) $5, (51, 52) $55.65, (56) $10, (61) $2.50, (62) $3, (64) $0.50, (66,67) $12, (72) $5, (77) $6.50, (79) $1.50, (⅓ of 82) $22.50, (84) $9, (87) $20, (108) $12.25, (292) $1, (295, 296) $10, and no others can properly be credited 222 10

Net profits for period No. 3 ..... $14,947 65

And that during the period from May 1, 1881, to April 30, 1883, both inclusive, defendants made and sold—

611	¾" and 1"	brass valves at a profit of	$558 20
44	¾"	" " " no profit.	
2,742	1¼"	" " " a profit of	1,547 05
817	1¼"	" " " no profit.	
631	1½"	" " " a profit of	1,441 75
6	1½"	" " " no profit.	
178	2"	" " " a profit of	503 00
20	2"	" " " no profit.	
77	2½"	" " " a profit of	240 50
893	2½"	" " " a profit of	4,356 50
111	2½"	" " " no profit.	
197	3"	" " " a profit of	1,822 00

133

89	3″ brass valves at no profit.		
152	2″ iron " " a profit of		$488 75
8	2″ " " " no profit.		
177	2½″ " " " a profit of		1,058 50
9	2½″ " " " no profit.		
135	3″ " " " a profit of		1,128 98
1	3″ " " " no profit.		
46	3½″ " " " a profit of		317 00
1	3½″ " " " no profit.		
23	4″ " " " a profit of		220 25
1	4″ " " " no profit.		
6	5″ " " " a profit of		95 00
3	5″ " " " no profit.		
1	6″ " " " no profit.		
6,979			
	Making the profits for the fourth period		$13,777 48
	On which the items of account of valves returned, etc. (75, 76) $11.50, (81) $5.50, (⅔ of 82) $45, (89) $15, (90) $1, (91, 92) $8.25, (99, 101) $31.80, (106, 107) $7.50, (113, 114) $10, (116, 117, 118) $28.25, (121, 122, 125 to 128) $115.50, (143) $5, (150) $37.50, (297 to 299) $3.70, (300, 302) $9.60, (315) $9.61, and no others can properly be credited		244 71
	Net profits for period No. 4		$13,532 77

And that during the period from May 1, 1883, to Sept. 24, 1883, both inclusive, defendants made and sold—

351	¾″ and 1″ brass valves at a profit of		$317 40
8	¾″ " 1″ " " " no profit.		
2,027	1¼″ " " " a profit of		1,621 82
337	1½″ " " " a profit of		766 00
2	1½″ " " " no profit.		
75	2″ " " " a profit of		236 00
6	2″ " " " no profit.		
28	2½″ " " " a profit of		115 00

134

30	2½″ brass valves at no profit.		
272	2½″ " " " a profit of		1,579 75
10	2½″ " " " no profit.		
30	3″ " " " a profit of		260 50
80	3″ " " " no profit.		
83	2″ " " " a profit of		216 90
68	2½″ " " " a profit of		331 30
64	3″ " " " a profit of		421 23
7	3½″ " " " a profit of		52 75

23	4″	"	"	" a profit of		169 00
5	5″	iron	"	" a profit of		56 75
1	5″	"	"	" no profit.		
3,507						
				Making the profits for the fifth period		$6,144 40
				On which the items of "account valves returned, etc." (130, 131) $5.20, (140) $30, (141) $15, (144, 148, 151, 152) $47.70, (164, 166, 312) $9.00, and no others can properly be credited		106 90
				Net profits for period No. 5		$6,037 50

And making the net profits for which defendants are accountable during the term of the Richardson patent of Sept. 25, 1866, as follows:

Feb. 19, 1879, to	April	30,	1880		$8,289 60
May 1, 1880, "	"	"	1881		9,891 10
" " 1881, "	"	"	1882		14,947 65
" " 1882, "	"	"	1883		13,532 77
" " 1883, "	Sept.	24,	1883		6,037 50
					$52,698 62

Fifty-two thousand six hundred ninety-eight $\frac{62}{100}$ dollars, all proper deductions and allowances being made and all and every expense being paid, and the above fund having been available for dividend fund over and above the interest on capital actually invested in the business.

The details of the valve sales as above summarized are in the following schedules:

135 *Schedule of Profits of Valves Sold Above Cost.*

February, 1879, to May 1, 1880.

				Profit.	Total profit.
1″ and 1¼″	Cost not exceeding $4 00 each.				
	Sold @	4 10	90	$0 10	$9 00
	"	4 25	24	25	6 00
	"	4 27½	42	27½	11 55
	"	4 50	170	50	85 00
	"	4 75	132	75	99 00
	"	5 00	1,508	1 00	1,508 00
	"	6 00	32	2 00	64 00
	"	7 00	2	3	6 00
	"	7 50	7	3 50	24 50
	"	8 00	1	4	4 00
	"	9 00	1	5	5 00
	"	10 50	2	6 50	13 00
			2,011		$1,835 05

1½″	Cost not exceeding $5 00 each.				
	Sold @	6 00	17	$1 00	$17 00
	"	8 00	23	3 00	69 00
	"	8 75	7	3 75	26 25
	"	10 00	4	5 00	20 00
	"	12 50	6	7 50	45 00
	"	15 00	1	10 00	10 00
			58		$187 25
2″	Cost not exceeding $8 00 each.				
	Sold @	10 00	6	$2 00	$12 00
	"	11 25	1	3 25	3 25
	"	12 00	31	4 00	124 00
	"	12 25	6	4 25	25 50
	"	14 00	1	6 00	6 00
	"	15 00	3	7 00	21 00
	"	18 00	1	10 00	10 00
136			49		$201 75
2¼″	Cost not exceeding $13 10 each.				
	Sold @	15 00	2	$1 90	$3 80
	"	16 00	17	2 90	49 30
	"	18 00	3	4 90	14 70
	"	20 00	15	6 90	103 50
	"	23 00	12	9 90	118 80
	"	25 00	12	11 90	142 80
			61		$433 90
2½″	Cost not exceeding $13 10 each.				
	Sold @	13 25	44	$0 15	$6 60
	"	15 00	43	1 90	81 70
	"	20 00	183	6 90	1,262 70
	"	22 50	174	9 40	1,635 60
	"	23 00	4	9 90	39 60
	"	25 00	107	11 90	1,273 30
			555		$4,299 50
3″	Cost not exceeding $18 55 each				
	Sold @	26 00	3	$7 45	$22 35
	"	28 00	11	9 45	103 95
	"	30 00	1	11 45	11 45
	"	31 50	51	12 95	660 45
	"	32 50	12	13 95	167 40
	"	35 00	14	16 45	230 30
	"	45 50	1	26 95	26 95
	"	65 00	1	46 45	46 45
			94		$1,269 30

2″ iron.	Cost not exceeding $10 00 each.				
	Sold @	12 00	6	$2 00	$12 00
	"	13 50	1	3 50	3 50
	"	15 00	3	5 00	15 00
137			10		$30 50
2½″ iron.	Cost not exceeding $20 00 each.				
	Sold @	22 50	1	$2 50	$2 50
	"	37 50	2	17 50	35 00
			3		$17 50
3″ iron.	Cost not exceeding $25 00 each.				
	Sold @	28 00	3	$3 00	$9 00
	"	29 25	2	4 25	8 50
	"	29 42½	2	4 42½	8 85
	"	30 00	1	5 00	5 00
	"	32 50	2	7 50	15 00
	"	35 00	1	10 00	10 00
	"	36 00	1	11 00	11 00
	"	48 00	2	23 00	46 00
			14		$113 35
3½″ iron.	Cost not exceeding $30 00 each.				
	Sold @	35 00	3	$5 00	$15 00

Schedule of Valves Sold at Cost or Less.

Feb. 1, 1879, to May 1, 1880.

1″ and 1¼″	sold at and below	$4 00,	192
1½″	" "	5 00,	25
2″	" "	8 00,	1
2½″	" "	13 10,	0
2½″	" "	13 10,	61
3″	" "	18 55,	20
2″ iron	" "	10 00,	0
2½″ "	" "	20 00,	3
3″ "	" "	25 00,	0
3½″ "	" "	30 00,	0
4″ "	" "	30 00,	0
			302

138 *May* 1, 1880, *to May* 1, 1881.

1″	Cost not exceeding $4 00 each.				
	Sold @	4 25	1	$0 25	$0 25
	"	4 50	26	50	13 00
	"	4 80	4	80	3 20
	"	5 00	2	1 00	2 00
	"	5 25	1	1 25	1 25
	"	6 00	2	2 00	4 00
	"	9 00	2	5 00	10 00
			38		$33 70

1¼″	Cost not exceeding $3 50 each.				
	Sold @	3 75	522	$0 25	$130 50
	"	3 85	75	35	26 25
	"	3 87½	120	37½	45 00
	"	3 90	100	40	40 00
	"	4 00	228	50	114 00
	"	4 10	150	60	90 00
	"	4 25	186	75	139 50
	"	4 50	185	1 00	185 00
	"	4 75	10	1 25	12 50
	"	5 00	560	1 50	840 00
	"	6 00	53	2 50	132 50
	"	7 00	1	3 50	3 50
	"	7 50	10	4 00	40 00
	"	8 00	6	4 50	27 00
	"	8 75	1	5 25	5 25
			2,207		$1,831 00
1½″	Cost not exceeding $5 50 each.				
	Sold @	6 00	38	$0 50	$19 00
	"	7 50	1	2 00	2 00
	"	8 00	70	2 50	175 00
	"	8 75	1	3 25	3 25
	"	10 00	12	4 50	54 00
			122		$253 25
139					
2″	Cost not exceeding $8 00 each.				
	Sold @	8 25	1	$0 25	$0 25
	"	9 50	4	1 50	6 00
	"	9 80	2	1 80	3 60
	"	10 00	51	2 00	102 00
	"	12 00	39	4 00	156 00
	"	12 25	6	4 25	25 50
	"	13 50	1	5 50	5 50
	"	14 00	1	6 00	6 00
	"	15 00	2	7 00	14 00
	"	20 00	1	12 00	12 00
	"	22 50	1	14 50	14 50
			109		$345 35
2¼″	Cost not exceeding $13 25 each.				
	Sold @	15 00	49	$1 75	$85 75
	"	16 00	6	2 75	16 50
	"	17 50	4	4 25	17 00
	"	18 00	1	4 75	4 75
	"	20 00	4	6 75	27 00
			64		$151 00

2½″	Cost not exceeding $13 25 each.				
	Sold @	14 50	18	1 25	$22 50
	"	15 00	178	1 75	311 50
	"	17 50	2	4 25	8 50
	"	20 00	202	6 75	1,363 50
	"	21 50	24	8 25	198 00
	"	22 50	106	9 25	980 50
	"	23 00	7	9 75	68 25
	"	25 00	119	11 75	1,398 25
	"	28 00	6	14 75	88 50
			662		$4,439 50
3″	Cost not exceeding $18 55 each.				
	Sold @	26 00	14	$7 45	$104 30
	"	28 00	16	9 45	151 20
	"	30 00	9	11 45	103 05
140	"	31 50	76	12 95	984 20
	"	32 00	18	13 45	242 10
	"	32 50	2	13 95	27 90
	"	35 00	18	16 45	296 10
	"	48 75	1	30 20	30 20
			154		$1,939 05
2″ iron.	Cost not exceeding $10 00 each.				
	Sold @	12 00	12	$2 00	$24 00
	"	15 00	1	5 00	5 00
	"	18 00	1	8 00	8 00
			14		$37 00
2½″ iron.	Cost not exceeding $15 00 each.				
	Sold @	16 00	2	$1 00	$2 00
	"	18 00	1	3 00	3 00
	"	18 75	4	3 75	15 00
	"	20 00	28	5 00	140 00
	"	22 50	3	7 50	22 50
	"	25 00	1	10 00	10 00
	"	37 50	1	22 50	22 50
			40		$215 00
3″ iron.	Cost not exceeding $19 50 each.				
	Sold @	20 00	1	$0 50	$0 50
	"	22 00	1	2 50	2 50
	"	25 00	3	5 50	16 50
	"	26 00	9	6 50	58 50
	"	28 00	1	8 50	8 50
	"	32 50	2	13 00	26 00
	"	35 00	1	15 50	15 50
	"	42 00	3	22 50	67 50
	"	48 75	7	29 25	204 75
			28		$400 25

141

3½″ iron.	Cost not exceeding $26 00 each.				
	Sold @	30 00	4	$4 00	$16 00
	"	32 00	6	6 00	36 00
	"	32 50	2	6 50	13 00
	"	33 00	1	7 00	7 00
	"	40 00	1	14 00	14 00
			14		$86 00
4″ iron.	Cost not exceeding $28 00 each.				
	Sold @	30 00	1	$2 00	$2 00
	"	32 50	13	4 50	58 50
	"	38 00	9	10 00	90 00
	"	38 50	4	10 50	42 00
	"	40 00	4	12 00	48 00
			31		$240 50

May 1, 1880, *to May* 1, 1881.

1″	sold at and below	$4 00,	62
1¼″	" " " "	3 50,	124
1½″	" " " "	5 50,	35
2″	" " " "	8 00,	19
2¼″	" " " "	13 25,	0
2½″	" " " "	13 25,	61
3″	" " " "	18 55,	36
2″ iron	" " " "	10 00,	1
2½″	" " " "	15 00,	6
3″	" " " "	19 50,	10
3½″	" " " "	26 00,	1
4″	" " " "	28 00,	2
			357

May 1, 1881, *to May* 1, 1882.

1	Cost not exceeding $3 60 each.				
	Sold @	2 68	342	$0 15	$40 20
	"	4 00	25	40	10 00
	"	4 20	5	60	3 00
142	"	4 50	38	0 90	34 20
	"	4 80	116	1 20	139 20
	"	5 00	3	1 40	4 20
	"	5 40	1	1 80	1 80
	"	6 00	3	2 40	7 20
			459		$239 80

1¼″	Cost not exceeding $2 87½ each.				
	Sold @ 3 05	12	$0 17½	$2 10	
	" 3 50	84	62½	52 50	
	" 3 70	25	82½	20 62½	
	" 3 75	1,337	87½	1,169 87½	
	" 3 80	64	92½	59 20	
	" 3 85	125	97½	121 87½	
	" 3 87½	12	1 00	84 00	
	" 3 88⅓	12	1 00⅚	12 10	
	" 3 90	174	1 02½	178 35	
	" 4 00	614	1 12½	690 75	
	" 4 25	56	1 37½	77 00	
	" 4 50	148	1 62½	240 50	
	" 4 75	7	1 87½	13 12½	
	" 5 00	150	2 12½	318 75	
	" 5 25	17	2 37½	40 37½	
	" 7 00	111	3 12½	346 87½	
	" 6 50	1	3 62½	3 62½	
	" 6 66⅔	6	3 79⅙	22 75	
	" 7 50	6	4 62½	27 75	
	" 9 00	1	6 12½	6 12½	
		3,034		$3,488 25	
1½″	Cost not exceeding $4 25 each.				
	Sold @ 5 50	77	$1 25	$96 25	
	" 5 75	35	1 50	52 50	
	" 6 00	97	1 75	169 75	
	" 6 50	1	2 25	2 25	
	" 7 00	10	2 75	27 50	
143	" 7 50	24	3 25	78 00	
	" 7 60	37	3 35	123 95	
	" 8 00	74	3 75	277 50	
	" 9 50	3	5 25	15 75	
	" 10 00	1	5 75	5 75	
	" 12 00	1	7 75	7 75	
	" 22 50	12	18 25	219 00	
		372		$1,075 95	
2″	Cost not exceeding $7 25 each.				
	Sold @ 8 00	31	$0 75	$23 25	
	" 8 50	14	1 25	17 50	
	" 9 00	20	1 75	35 00	
	" 9 50	34	2 25	76 50	
	" 10 00	9	2 75	24 75	
	" 10 50	7	3 25	22 75	
	" 11 50	3	4 25	12 75	
	" 12 00	67	4 75	318 25	
	" 15 00	6	7 75	46 50	
	" 21 00	1	13 75	13 75	
		192		$591 00	

2¼″	Cost not exceeding $12 50 each.				
	Sold @	15 00	33	$2 50	$82 50
	"	16 00	2	3 50	7 00
	"	20 00	2	7 50	15 00
			37		$104 50
2½″	Cost not exceeding $13 25 each.				
	Sold @	13 50	68	$0 25	$17 00
	"	15 00	269	1 75	470 75
	"	17 50	9	4 25	38 25
	"	18 00	3	4 75	14 25
	"	20 00	300	6 75	2,025 00
	"	21 00	2	7 75	15 50
	"	21 50	44	8 25	263 00
	"	22 50	119	9 25	1,100 75
	"	23 00	9	9 75	87 75
	"	25 00	137	11 75	1,609 75
			960		$5,742 00
144					
3″	Cost not exceeding $16 00 each.				
	Sold @	19 50	2	$3 50	$7 00
	"	22 75	5	6 75	33 75
	"	26 00	57	10 00	570 00
	"	27 50	4	11 50	46 00
	"	31 50	53	15 50	821 50
	"	32 50	3	16 50	49 50
	"	26 00	12	10 00	120 00
	"	28 00	11	12 00	132 00
			147		$1,779 75
2″ iron.	Cost not exceeding $8 50 each.				
	Sold @	9 00	12	$0 50	$6 00
	"	10 00	2	1 50	3 00
	"	10 50	25	2 00	50 00
	"	12 00	21	3 50	73 50
	"	13 50	9	5 00	45 00
	"	14 00	3	5 50	16 50
	"	15 00	2	6 50	13 00
	"	22 50	1	14 00	14 00
			75		$221 00
2½″ iron.	Cost not exceeding $15 00 each.				
	Sold @	15 25	2	$0 25	$0 50
	"	16 50	2	1 50	3 00
	"	17 50	22	2 50	55 00
	"	20 00	24	5 00	120 00
	"	21 00	1	6 00	6 00
	"	22 00	1	7 00	7 00

	Sold @ $24 75	2	$9 75	$19 50
	" 25 00	3	10 00	30 00
	" 26 00	1	11 00	11 00
	" 35 00	1	20 00	20 00
	" 37 50	3	22 50	67 50
		62		$339 50

145

3" iron. Cost not exceeding $17 00 each.

Sold @ 19 50	48	$2 50	$120 00
" 22 50	2	5 50	11 00
" 22 75	12	5 75	69 00
" 25 00	5	8 00	40 00
" 26 00	25	9 00	225 00
" 29 25	2	12 25	24 50
" 30 00	2	13 00	26 00
" 32 50	4	15 50	62 00
" 33 75	2	16 75	33 50
" 35 00	3	18 00	54 00
" 39 00	6	22 00	132 00
" 48 75	7	31 75	222 25
	118		$1,019 25

3½" iron. Cost not exceeding $24 00 each.

Sold @ 26 00	1	$2 00	$2 00
" 28 00	5	4 00	20 00
" 32 00	12	8 00	96 00
" 35 00	8	11 00	88 00
	26		$206 00

4" iron. Cost not exceeding $28 00 each.

Sold @ 30 00	3	$2 00	$6 00
" 32 50	12	4 50	54 00
" 35 00	1	7 00	7 00
" 38 50	4	10 50	42 00
" 40 00	6	12 00	72 00
" 50 00	5	22 00	110 00
	31		$291 00

5" iron. Cost not exceeding $43 75 each.

Sold @ 46 00	3	$2 25	$6 75
" 55 00	3	11 25	33 75
" 75 00	1	31 25	31 25
	7		$71 75

146 *May* 1, 1881, *to May* 1, 1882.

¼″ and 1″	sold at and below	$3	60,		47
1¼″	" " "	2	87½,		50
1½″	" " "	4	25,		50
2″	" " "	7	25,		31
2½″	" " "	12	50,		1
2½″	" " "	13	25,		200
3″	" " "	16	00,		224
2″ iron	" " "	8	50,		2
2½″ "	" " "	15	00,		22
3″ "	" " "	17	00,		0
3½″ "	" " "	24	00,		187
4″ "	" " "	28	00,		166
5″ "	" " "	43	75,		2
					982

May 1, 1882, *to May* 1, 1883.

1″	Cost not exceeding $3 00 each.				
	Sold @	3 25	55	$0 25	$13 75
	"	3 50	108	0 50	54 00
	"	3 60	45	0 60	27 00
	"	3 75	176	0 75	132 00
	"	4 00	82	1 00	82 00
	"	4 20	13	1 20	15 60
	"	4 25	1	1 25	1 25
	"	4 50	60	1 50	90 00
	"	4 80	52	1 80	93 60
	"	5 00	8	2 00	16 00
	"	5 40	4	2 40	9 60
	"	6 00	5	3 00	15 00
	"	7 20	2	4 20	8 40
			611		$558 20
1¼″	Cost not exceeding $3 50 each.				
	Sold @	3 70	162	$0 20	$32 40
	"	3 75	1,326	0 25	331 50
	"	3 85	100	0 35	35 00
147	Sold @	3 87½	12	0 37½	4 50
	"	4 00	544	0 50	272 00
	"	4 25	61	0 75	45 75
	"	4 50	286	1 00	286 00
	"	4 58⅓	3	1 08⅓	3 25
	"	4 75	4	1 25	5 00
	"	5 00	106	1 50	159 00
	"	5 25	17	1 75	29 75
	"	6 00	91	2 50	227 00
	"	6 48	5	2 98	14 90

	Sold @	$6 75	1	$3 25	$3 25
	"	7 29⅛	12	3 79⅛	45 50
	"	7 50	11	4 00	44 00
	"	11 25	1	7 75	7 75
			2,742		$1,547 05
1½"	Cost not exceeding $4 00 each.				
	Sold @	4 50	6	$0 50	$3 00
	"	4 75	94	75	70 50
	"	5 00	55	1 00	55 00
	"	5 25	6	1 25	7 50
	"	5 41⅔	12	1 41⅔	17 00
	"	5 50	54	1 50	81 00
	"	5 75	9	1 75	15 75
	"	6 00	193	2 00	386 00
	"	7 00	25	3 00	75 00
	"	7 50	61	3 50	213 50
	"	8 00	89	4 00	356 00
	"	9 00	1	5 00	5 00
	"	9 50	3	5 50	16 50
	"	10 00	22	6 00	132 00
	"	12 00	1	8 00	8 00
			631		$1,441 75
148					
2"	Cost not exceeding $7 25 each.				
	Sold @	8 00	10	$ 75	$7 50
	"	9 00	63	1 75	110 25
	"	9 50	24	2 25	54 00
	"	10 00	20	2 75	55 00
	"	10 50	9	3 25	29 25
	"	12 00	52	4 75	247 00
			178		$503 00
2½"	Cost not exceeding $12 50 each.				
	Sold @	14 00	6	$1 50	$9 00
	"	15 00	39	2 50	97 50
	"	16 00	22	3 50	77 00
	"	16 50	1	4 00	4 00
	"	17 50	7	5 00	35 00
	"	18 00	1	5 50	5 50
	"	25 00	1	12 50	12 50
			77		$240 50
2½"	Cost not exceeding $13 25 each.				
	Sold @	13 50	119	$0 50	$59 50
	"	15 00	292	1 75	511 00
	"	16 00	7	2 75	19 25
	"	16 50	1	3 25	3 25

	Sold @	17 00	12	$3 75	$45 00
	"	17 50	23	4 25	97 75
	"	18 00	11	4 75	52 25
	"	19 25	2	6 00	12 00
	"	20 00	234	6 75	1,579 50
	"	21 50	15	8 25	123 75
	"	22 00	3	8 75	26 25
	"	22 50	86	9 25	795 50
	"	22 75	1	9 50	9 50
	"	24 75	1	11 50	11 50
	"	25 00	86	11 75	1,010 50
			893		$4,356 50

149

3"	Cost not exceeding $16 00 each.				
	Sold @	19 50	12	$3 50	$42 00
	"	20 00	35	4 00	140 00
	"	22 50	5	6 50	32 50
	"	22 75	10	6 75	67 50
	"	26 00	97	10 00	970 00
	"	27 50	1	11 50	11 50
	"	29 25	8	13 25	106 00
	"	30 00	2	14 00	28 00
	"	31 50	21	15 50	325 50
	"	32 50	6	16 50	99 00
			197		$1,822 00
2" iron.	Cost not exceeding $8 50 each.				
	Sold @	9 00	31	$0 50	$15 50
	"	10 00	2	1 50	3 00
	"	10 50	50	2 00	100 00
	"	12 00	24	3 50	84 00
	"	12 25	9	3 75	33 75
	"	13 50	8	5 00	40 00
	"	14 00	3	5 50	16 50
	"	15 00	15	6 50	97 50
	"	17 50	8	9 00	72 00
	"	20 00	1	11 50	11 50
	"	23 50	1	15 00	15 00
			152		$488 75
2½" iron.	Cost not exceeding $12 50 each.				
	Sold @	15 00	47	$2 50	$117 50
	"	16 00	1	3 50	3 50
	"	16 50	25	4 00	100 00
	"	17 50	33	5 00	165 00
	"	19 25	8	6 75	54 00
	"	19 50	1	7 00	7 00
	"	20 00	30	7 50	225 00

	Sold @	22 00	7	$9 50	$66 50
	"	22 50	6	10 00	60 00
	"	24 75	2	12 25	24 50
150	Sold @	25 00	16	12 50	200 00
	"	27 50	1	15 00	15 00
	"	35 00	2	22 50	45 00
			177		$1,058 50

3″ iron. Cost not exceeding $16 00 each.

	Sold @	19 50	42	$3 50	$147 00
	"	20 00	3	4 00	12 00
	"	21 61½	2	5 61½	11 23
	"	22 00	1	6 00	6 00
	"	22 50	4	6 50	26 00
	"	22 75	27	6 75	182 25
	"	26 00	27	10 00	270 00
	"	26 25	7	10 25	71 75
	"	29 25	2	13 25	26 50
	"	30 00	1	14 00	14 00
	"	32 50	16	16 50	264 00
	"	48 75	3	32 75	98 25
			135		$1,128 98

3½″ iron. Cost not exceeding $22 75 each.

	Sold @	24 00	3	$1 25	$3 75
	"	26 00	2	3 25	6 50
	"	26 60	5	3 85	19 25
	"	27 00	1	4 25	4 25
	"	28 00	21	5 25	110 25
	"	31 50	1	8 75	8 75
	"	32 00	5	9 25	46 25
	"	36 00	5	13 25	66 25
	"	40 00	3	17 25	51 75
			46		$317 00

4″ iron. Cost not exceeding $28 00 each.

	Sold @	30 00	5	$2 00	$10 00
	"	32 50	2	4 50	9 00
	"	33 00	2	5 00	10 00
151	Sold @	33 25	1	5 25	5 25
	"	40 00	7	12 00	84 00
	"	44 00	5	16 00	80 00
	"	50 00	1	22 00	22 00
			23		$220 25

5″ iron.	Cost not exceeding $37 50 each.				
	Sold @	45 00	2	$7 50	$15 00
	"	50 00	1	12 50	12 50
	"	52 50	2	15 00	30 00
	"	75 00	1		37 50
			6		$95 00

May 1, 1882, *to May* 1, 1883.

¾″ and 1″	sold at and below	$3 00,				44
1¼″	"	"	"	3 50,		817
1½″	"	"	"	4 00,		6
2″	"	"	"	7 25,		20
2½″	"	"	"	13 25,		111
3″	"	"	"	16 00,		89
2″ iron	"	"	"	8 50,		8
2½″	"	"	"	12 50,		9
3″	"	"	"	16 00,		1
3½″	"	"	"	22 75,		1
4″	"	"	"	28 00,		1
5″	"	"	"	37 50,		3
6″	"	"	"	60 00,		1
						1,111

May 1, 1883, *to Sept.* 25, 1883.

¾″ and 1″	Cost not exceeding $3 00 each.				
	Sold @	3 25	25	$0 25	$6 25
	"	3 50	138	50	69 00
	"	3 60	22	60	13 20
	"	3 75	32	75	24 00
152	Sold @	3 85	1	0 85	0 85
	"	4 00	22	1 00	22 00
	"	4 20	7	1 20	8 40
	"	4 50	61	1 50	91 50
	"	4 80	34	1 80	61 20
	"	5 00	6	2 00	12 00
	"	6 00	3	3 00	9 00
			351		$317 40
1½″	Cost not exceeding $3 00 each.				
	Sold @	3 25	84	$0 25	$21 00
	"	3 50	661	50	330 50
	"	3 65	12	65	7 80
	"	3 70	160	70	112 00
	"	3 75	641	75	480 75
	"	3 85	3	85	2 55
	"	3 87½	18	87½	15 82
	"	4 00	251	1 00	251 00

	Sold @	$4 25	24	$1 25	$30 00
	"	4 50	84	1 50	126 00
	"	4 75	4	1 75	7 00
	"	5 00	22	2 00	44 00
	"	5 25	4	2 25	9 00
	"	5 40	1	2 40	2 40
	"	6 00	53	3 00	159 00
	"	7 50	4	4 50	18 00
	"	8 00	1	5 00	5 00
			2,027		$1,621 82

1½″ Cost not exceeding $3 50 each.

	Sold @	4 25	100	$0 75	$75 00
	"	4 75	8	1 25	10 00
	"	5 00	20	1 50	30 00
	"	5 50	27	2 00	54 00
	"	6 00	104	2 50	260 00
	"	6 66⅔	6	3 16⅔	19 00
	"	7 00	16	3 50	56 00
153	Sold @	7 50	15	4 00	60 00
	"	8 00	31	4 50	139 50
	"	9 00	2	5 50	11 00
	"	9 50	3	6 00	18 00
	"	10 00	4	6 50	26 00
	"	11 00	1	7 50	7 50
			257		$766 00

2″ Cost not exceeding $7 25 each.

	Sold @	8 00	26	$0 75	$19 50
	"	8 50	2	1 25	2 50
	"	9 00	4	1 75	7 00
	"	10 00	1	2 75	2 75
	"	10 50	13	3 25	42 25
	"	12 00	17	4 75	80 75
	"	12 25	1	5 00	5 00
	"	13 50	3	6 25	18 75
	"	14 00	7	6 75	47 25
	"	17 50	1	10 25	10 25
			75		$236 00

2½″ Cost not exceeding $12 00 each.

	Sold @	15 00	12	$3 00	$36 00
	"	16 00	11	4 00	44 00
	"	17 50	2	5 50	11 00
	"	20 00	3	8 00	24 00
			28		$115 00

2½″	Cost not exceeding $13 25 each.				
	Sold @	13 50	58	$0 25	$14 50
	"	15 00	54	1 75	94 50
	"	16 50	1	3 25	3 25
	"	17 25	1	4 00	4 00
	"	17 50	2	4 25	8 50
	"	18 00	2	4 75	9 50
	"	18 50	6	5 25	31 50
	"	20 00	33	6 75	222 75
	"	22 50	64	9 25	592 00
	"	25 00	51	11 75	599 25
			272		$1,579 75
154					
3″ iron.	Cost not exceeding $16 00 each.				
	Sold @	17 25	1	$1 25	$1 25
	"	19 50	12	3 50	42 00
	"	22 50	1	6 51	6 50
	"	22 75	3	6 75	20 25
	"	26 00	2	10 00	20 00
	"	30 00	1	14 00	14 00
	"	31 50	8	15 50	124 00
	"	32 25	2	16 25	32 50
			30		$260 50
2″ iron.	Cost not exceeding $8 50 each.				
	Sold @	9 00	36	$0 50	$18 00
	"	10 45	2	1 95	3 90
	"	10 50	27	2 00	54 00
	"	12 00	5	3 50	17 50
	"	14 00	1	5 50	5 50
	"	15 00	2	6 50	13 00
	"	19 00	10	10 50	105 00
			83		$216 90
2½″ iron.	Cost not exceeding $12 50 each.				
	Sold @	15 00	29	$2 50	$72 50
	"	16 50	9	4 00	36 00
	"	16 65	2	4 15	8 30
	"	17 50	17	5 00	85 00
	"	18 00	1	5 50	5 50
	"	20 00	3	7 50	22 50
	"	22 00	2	9 50	19 00
	"	25 00	3	12 50	37 50
	"	30 00	1	17 50	17 50
	"	40 00	1	27 50	27 50
			68		$331 30

155

3″ iron.	Cost not exceeding $16 00 each.				
	Sold @	19 50	26	$3 50	$91 00
	"	21 11½	2	5 11½	10 23
	"	22 50	8	6 50	52 00
	"	22 75	14	6 75	94 50
	"	26 00	3	10 00	30 00
	"	26 25	1	10 25	10 25
	"	28 00	3	12 00	36 00
	"	29 25	1	13 25	13 25
	"	30 00	6	14 00	84 00
			64		$421 23
3½″ iron.	Cost not exceeding $22 75 each.				
	Sold @	24 00	2	$1 25	$2 50
	"	28 00	2	5 25	10 50
	"	32 00	1	9 25	9 25
	"	36 00	1	13 25	13 25
	"	40 00	1	17 25	17 25
			7		$52 75
4″ iron.	Cost not exceeding $28 00 each.				
	Sold @	30 00	7	$2 00	$14 00
	"	33 00	2	5 00	10 00
	"	35 00	5	7 00	35 00
	"	38 50	4	10 50	42 00
	"	40 00	3	12 00	36 00
	"	44 00	2	16 00	32 00
			23		$169 00
5″ iron.	Cost not exceeding $37 50 each.				
	Sold	40 50	2	$3 00	$6 00
	" @	47 25	1		9 75
	"	56 00	1		18 00
	"	60 00	1		22 50
			5		$56 75

156 May 1, 1883, to Sept. 25, 1883.

¾″ and 1″	sold at and below	$3 00,	8
1¼″	" " " "	3 00,	0
1½″	" " " "	3 50,	2
2″	" " " "	7 25,	6
2¼″	" " " "	12 00,	30
2½″	" " " "	13 25,	10
3″	" " " "	16 00,	80
2″ iron	" " " "	8 50,	0
2½″ "	" " " "	12 50,	0
3″ "	" " " "	16 00,	0

3½″	"	"	"	"	"	22 75,		0
4″	"	"	"	"	"	28 00,		0
5″	"	"	"	"	"	37 50,		1
								137

* * * * * * *

The items of the "account of valves returned, etc., Nos. 1 and 2," have, by the system of making up the foregoing account, all being allowed for except (2) and the 2″ of (70), which is not in the sales account; (195) and (201) in No. 1, the last two being insufficiently understood; (282–286), (317), (318), which do not belong in the account or period, and (330), included by the system of ascertaining cost as part of cost.

* * * * * * *

157 And complainants further say, in case No. 1184, that had not the valves hereinbefore scheduled in this charge contained the invention patented to George W. Richardson Sept. 25, 1866, and the property of the complainants, the defendants could not have sold the said valves for any greater sum of money than hereinbefore taken as the cost thereof, and that by virtue of containing the said invention, and for no other reason or reasons, the defendants were enabled to sell the valves hereinbefore scheduled at a profit of $52,698.62, which they would not otherwise have realized; and complainants aver that the sum of $52,698.62 was the profits derived by the defendants from their unauthorized use of the Richardson patent of 1866, as above set forth.

* * * * * * *

158 And complainants further aver that it appears from defendants' returns to the State of Massachusetts to and including the thirtieth day of April, 1879, that the surplus of defendants' business was then ---------- $13,649 26
And from their dividend account that defendants made and paid in dividends the sum of---------- 3,000 00
during the year 1879, leaving carried over from the year 1878 the sum of---------- 10,629 26
as a surplus.
And that it appears from their returns, including the 30th of April, 1880, that the surplus on that day was 29,483 16
showing the profits of the year from May 1, 1879, to April 20, 1880, to have been---------- 18,834 90
of which complainants aver that about---------- 8,289 60
belonged to the valve business.
And that from the surplus of---------- 29,483 16
existing on the 1st of May, 1880, there was paid the sum of ---------- 3,000 00
leaving as a surplus from the preceding year the sum of 26,483 16

And that on the 30th day of April, 1881, the defendants by their report showed a surplus of ---- 44,867 27
showing the profits of their business during the year to be ---- 18,384 11
159 of which complainants aver that ---- 9,891 10
were due to their valve business.
And that from the surplus of ---- 44,867 27
on the 1st of May, 1881, there was paid during the fiscal year a dividend of ---- 14,350 00
leaving of the surplus existing at the beginning of the year the sum of ---- 30,517 27
And that on the 30th of April, 1882, the defendants reported a surplus of ---- 75,031 74
making their profits for the year ---- 44,514 47
of which complainants aver that the sum of ---- 14,947 65
was properly chargeable to the valve business.
And that of the surplus of ---- 75,031 74
existing on the first day of May, 1882, defendants paid in a stock dividend the sum of ---- 70,000 000
thereby increasing the valuation held by the stockholders 233⅓ per cent., and leaving as a net surplus the sum of ---- 5,031 74
And that the defendants paid out in dividends during the period from May 1, 1882, to April 30, 1883, the sum of ---- 26,408 00
making of earnings during the period, deducting the net surplus above referred to, paid out in dividends, the sum of ---- 21,477 26
and reported as a surplus, on April 30, 1883, the sum of ---- 26,143 39
making of earnings during the year, applicable to a dividend fund ---- 48,879 65
of which complainants aver that ---- 13,532 77
are properly chargeable as the profits of the valve business.
And that the defendants, during the period from May 1, 1883, to April 30, 1884, paid out in dividends the sum of ---- 31,848 00
and reported a surplus on the 30th of April, 1884, of ---- 35,429 02
showing the earnings applicable to dividends during the period, deducting the surplus at the beginning of the period, to have been ---- 41,133 63
160 of which sum the defendants aver that the profits of the valve business were, between May 1, 1883, and Sept. 24, 1883, the sum of ---- 6,037 50
and during the period from Sept. 24, 1883, to May 1, 1884, the sum of ---- 7,190 10
or, in all ---- 13,227 60
And that during the period from May 1, 1884, to Jan. 31, 1885, the defendants paid out in dividends the sum of ---- 25,717 00

And that during the period of this accounting the defendants paid in cash dividends the sum of..... 104,383 00
and in stock dividends the sum of 70,000 00
being in all the sum of..... 174,383 00
And that at or about the period of the commencement of the accounting the surplus reported by the defendants, namely, on the first day of May, 1879, did not exceed the sum of 13,649 00
making the profits of their business during the period of the accounting paid out in dividends the sum of.. 160,734 00
all of which and more was earned during the period of the accounting; and that of this sum of earnings at least fifty-two thousand six hundred and ninety-eight $\frac{62}{100}$ dollars were the profits of defendants' infringing valve business between Feb. 19, 1879, and Sept. 24, 1883, as hereinbefore stated, and are to be assessed in case 1184, and that at least fifteen thousand and ninety-six $\frac{50}{100}$ dollars were the profits of defendants' infringing valve business in the period from Sept. 25, 1883, to Jan. 31, 1885, and are to be assessed in the case 1199.

* * * * * * *

161 Nos. 1184 and 1199.

Additional Charge in Damages. (*Filed with the Master June* 22, 1886.)

And the complainants say in each of the above-entitled causes as follows:

That they had the sole right during the period of this accounting to make and sell valves embodying the Richardson patents of 1866 and 1869 respectively, and to fix prices of valves, and that in the year 1878, after the organization of the complainant corporation, they did so fix the prices for valves and were prepared to supply the market for valves embodying in their construction the said two letters patent and the things patented therein; that the defendants, in making use of the complainants' property in said letters patent, were bound to conform to the prices set by the complainants on their said property and to realize for complainants from the unlawful sales made by the defendants embodying the complainants' said patented property at least the minimum price for each valve established by complainants and at which the complainants were selling said valves and to realize for complainants from their said sales an amount equal to what complainants would have realized had the defendants not been in competition, and that each and every sale made by the defendants during the period of this accounting would have been made by the complainants had the defendants not made such sale, and at least the prices estab-
162 lished by the complainants in the year 1879 as the minimum prices conceded to customers, or at some price greater than the minimum price.

No. 1184.

And that defendants sold to persons who were customers of complainants or with whom the complainants were in negotiation for sales, in direct competition with complainants, being persons, firms, and corporations named in the schedules hereinbefore filed, a great quantity of valves of various sizes, as enumerated in said statements, for which defendants received $167,495.02 during the period of the accounting in case 1184, which valves, if sold by complainants at their minimum prices of 1879, would have yielded to the complainants the sum of $279,539.50, and that defendants, by their sales of these valves during the period covered by the accounting at the said less price than complainants' minimum price in 1879, damaged the complainants by the sale of valves in the sum of *of* $112,044.48 during said period included in the case 1184.

* * * * * * *

No. 1184.

And that, in addition to the said damages in the two cases respectively as hereinabove set forth, the complainants, by the competition of the defendants for the same customers and the same trade at prices greatly lower than the prices made by the com-
163 plainants, obliged the complainants, in order to retain their trade, to sell the valves they did sell at prices much less than they otherwise would have done, amounting from first to last on the goods sold by the complainants under contracts made during the period of the competition of twenty-five per cent. on an average each year from the prices established by the complainants in the year 1879, being a total sum during the period of the accounting in case 1184 of $77,236.11, in addition to the sum of $112,044.48, making the total of damages suffered by the complainants during the period of the accounting in the case 1184, which defendants should pay to complainants for their unlawful use of the Richardson patent of 1866, the sum of $189,280.59.

* * * * * * *

CONSOLIDATED SAFETY VALVE CO.,
By their solicitor, THOS. WM. CLARKE.

* * * * * * *

164 *Defendants' Discharges. J. G. S., Master.*

Defendants' discharge.

No. 1184.

(Filed with the master Oct. 24, 1885.)

The defendants have already submitted to the master their account for the period embraced within this case, showing the sales of safety-valves, their cost in materials and labor, and the proportion of the expenses and losses applicable to said safety-valves which should be charged against them.

This account, which the defendants claim to be a just and proper representation of these facts, discloses an excess of sales over the charges made against them.

Of this their account and of their rights and position in the accounting before the master the defendants say:

1. That in case the master shall hold that the complainants are entitled to recover any sum for the profits made by the defendants for the infringement of letters patent granted to Geo. W. Richardson, dated Sept. 25, 1866, No. 58294, and any sum for damages
165 sustained by the complainants for such infringement, the defendants insist that in no event can any greater sum be found by the master against the defendants for profits received and damages inflicted than the sum of $20,000, because the said complainants have limited themselves in their bill of complaint to a recovery within such sum.

2. That in case the master shall find that the complainants have not limited themselves as to the amount of profits which they can recover the defendants insist that the master cannot allow any sum on account of damages in addition to said profits in case the amount of profits for which the defendants must account shall be ascertained to be a sum equal to or greater than twenty thousand dollars, because the complainants by their bill of complaint are precluded from claiming that their damages are in excess of twenty thousand dollars.

3. That the master in this case cannot allow to the complainants any sum whatever for damages sustained by them by reason of the infringement of said letters patent to Geo. W. Richardson, dated Sept. 25, 1866, No. 58294, in addition to any sum for profits which he shall find that the defendants must account for, and these defendants insist upon this ground in discharge of the complainants' charge, for the reason that any allowance for damages to the complainants in excess of profits for which the defendants must account will violate, if enforced, the rights of the defendants under the Constitution and laws of the United States.

4. That the complainant company acquired title to the said Geo. W. Richardson patent of Sept. 25, 1866, No. 58294, on, to wit, Feb. 15, 1879, and by the instrument of conveyance obtained no greater right in, to, or under said letters patent than the said Geo. W. Richardson at the date of such conveyance possessed, and were and are privies in estate with said Richardson in said patent; that prior to such conveyance of said letters patent the said Geo. W. Richardson dedicated to the public, as against his said patent, all and singular the inventions and improvements set forth in said Richardson patent of 1866, which he embraced or caused to be embraced in certain reissued letters patent granted to Henry Waterman, dated July 9, 1867, No. 2675, the same being founded on the original letters patent
166 to the same Waterman, dated Nov. 15, 1853, No. 10243; that said Richardson was a party to the procurement of such reissue patent, and voluntarily and of his own motion transferred to said Waterman reissue patent out of the said Richardson patent any and every feature of invention which is contained in said reissued

Waterman patent and not found in the original Waterman patent, if any such there be. Whereby the defendants insist in discharge of the complainants' charge that the said Waterman reissued patent is to be considered as an invention in the art of making steam-valves prior to the invention of the said Richardson and prior to any infringement by the defendants, and that the defendants ought not to account for any profits received from the manufacture and sale by them of steam safety-valves, except for such profits as have been derived from features of construction found in the same, which are contained in the said Richardson patent of 1866 and not embraced in the specification of the said Waterman reissued patent.

5. That the said Waterman reissued patent expired Nov. 15, 1874, and all the invention therein set forth became vested in the public, and that the defendants did not commence their manufacture of safety-valves until long after the expiration of said Waterman patent, to wit, in the year 1875. Wherefore these defendants insist in discharge of the charge of the complainants on profits and damages that the entire invention set forth in said Waterman reissued patent is to be considered by the master as a part of the known prior art in relation to safety-valves, and that no finding should be made against them for profit or for damages except for the infringement of some portion of the said Richardson patent (if any there be) not covered by the said Waterman reissued patent.

6. That the valves manufactured and sold by the defendants contain divers inventions and improvements, and are an aggregation of the several inventions described in the English letters patent to Ritchie in 1848 and in the English letters patent to Webster in 1857, and in the reissued letters patent to Waterman, to which are added the improvements described in the letters patent to Geo. H. Crosby, under which the defendants' valves are specially manufactured; that the whole sum which the master shall find as the profits which have accrued to the defendants, after deducting the
167 proper sums for bad debts, expenses, etc.—the balance remaining fairly referable to the said improvements and characteristics described in expired and existing patents—should be apportioned as follows: And in discharge of the complainants' charge the defendants say—

There should be assigned of said sum—

To the Ritchie and Webster patents, say, fifty per cent.

To the inventions and improvements of Geo. H. Crosby, say, forty per cent.

To the reissued Waterman patent or the Richardson patent of 1866 (to whichever of them the master shall find is entitled to the same), say, ten per cent.

Wherefore the defendants claim that the master should adjudge that no profits or damages have accrued to the complainants.

For the defendants, B. F. THURSTON,
J. H. MILLETT,
Solicitors and of Counsel.

This account, which the defendants claim to be a just and proper representation of these facts, discloses an excess of sales over the charges made against them.

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1. That in case the master shall hold that the complainants are entitled to recover any sum for the profits made by the defendants for the infringement of letters patent granted to Geo. W. Richardson, dated Sept. 25, 1866, No. 58294, and any sum for damages
165 sustained by the complainants for such infringement, the defendants insist that in no event can any greater sum be found by the master against the defendants for profits received and damages inflicted than the sum of $20,000, because the said complainants have limited themselves in their bill of complaint to a recovery within such sum.

2. That in case the master shall find that the complainants have not limited themselves as to the amount of profits which they can recover the defendants insist that the master cannot allow any sum on account of damages in addition to said profits in case the amount of profits for which the defendants must account shall be ascertained to be a sum equal to or greater than twenty thousand dollars, because the complainants by their bill of complaint are precluded from claiming that their damages are in excess of twenty thousand dollars.

3. That the master in this case cannot allow to the complainants any sum whatever for damages sustained by them by reason of the infringement of said letters patent to Geo. W. Richardson, dated Sept. 25, 1866, No. 58294, in addition to any sum for profits which he shall find that the defendants must account for, and these defendants insist upon this ground in discharge of the complainants' charge, for the reason that any allowance for damages to the complainants in excess of profits for which the defendants must account will violate, if enforced, the rights of the defendants under the Constitution and laws of the United States.

4. That the complainant company acquired title to the said Geo. W. Richardson patent of Sept. 25, 1866, No. 58294, on, to wit, Feb. 15, 1879, and by the instrument of conveyance obtained no greater right in, to, or under said letters patent than the said Geo. W. Richardson at the date of such conveyance possessed, and were and are privies in estate with said Richardson in said patent; that prior to such conveyance of said letters patent the said Geo. W. Richardson dedicated to the public, as against his said patent, all and singular the inventions and improvements set forth in said Richardson patent of 1866, which he embraced or caused to be embraced in certain reissued letters patent granted to Henry Waterman, dated July 9, 1867, No. 2675, the same being founded on the original letters patent
166 to the same Waterman, dated Nov. 15, 1853, No. 10243; that said Richardson was a party to the procurement of such reissue patent, and voluntarily and of his own motion transferred to said Waterman reissue patent out of the said Richardson patent any and every feature of invention which is contained in said reissued

Waterman patent and not found in the original Waterman patent, if any such there be. Whereby the defendants insist in discharge of the complainants' charge that the said Waterman reissued patent is to be considered as an invention in the art of making steam-valves prior to the invention of the said Richardson and prior to any infringement by the defendants, and that the defendants ought not to account for any profits received from the manufacture and sale by them of steam safety-valves, except for such profits as have been derived from features of construction found in the same, which are contained in the said Richardson patent of 1866 and not embraced in the specification of the said Waterman reissued patent.

5. That the said Waterman reissued patent expired Nov. 15, 1874, and all the invention therein set forth became vested in the public, and that the defendants did not commence their manufacture of safety-valves until long after the expiration of said Waterman patent, to wit, in the year 1875. Wherefore these defendants insist in discharge of the charge of the complainants on profits and damages that the entire invention set forth in said Waterman reissued patent is to be considered by the master as a part of the known prior art in relation to safety-valves, and that no finding should be made against them for profit or for damages except for the infringement of some portion of the said Richardson patent (if any there be) not covered by the said Waterman reissued patent.

6. That the valves manufactured and sold by the defendants contain divers inventions and improvements, and are an aggregation of the several inventions described in the English letters patent to Ritchie in 1848 and in the English letters patent to Webster in 1857, and in the reissued letters patent to Waterman, to which are added the improvements described in the letters patent to Geo. H. Crosby, under which the defendants' valves are specially manufactured; that the whole sum which the master shall find as the profits which have accrued to the defendants, after deducting the
167 proper sums for bad debts, expenses, etc.—the balance remaining fairly referable to the said improvements and characteristics described in expired and existing patents—should be apportioned as follows: And in discharge of the complainants' charge the defendants say—

There should be assigned of said sum—

To the Ritchie and Webster patents, say, fifty per cent.

To the inventions and improvements of Geo. H. Crosby, say, forty per cent.

To the reissued Waterman patent or the Richardson patent of 1866 (to whichever of them the master shall find is entitled to the same), say, ten per cent.

Wherefore the defendants claim that the master should adjudge that no profits or damages have accrued to the complainants.

For the defendants, B. F. THURSTON,
J. H. MILLETT,
Solicitors and of Counsel.

Nos. 1184 and 1199.

168 *Defendants' Additional Discharge.*

And now come the defendants and, in addition to their discharge already filed in this cause, and in further discharge of the complainants' charge, modified charge, and additional charge severally filed therein, deny that the said complainants ever made and sold any safety-valves called or known as the Richardson valves, which were constructed in accordance with the Richardson patents of
169 1866 and 1869; that no such safety-valves were ever introduced or came into use, and that no safety-valves so constructed would be prudent or economical safety appliances; that the safety-valves made and sold by the complainants during the period of this accounting embraced only those features of expansion, chamber, and stricture which the public had a common right to employ in the making of a safety-valve, and therefore of which they had no exclusive possession.

And the defendants further say that any market or business the complainants established for safety-valves was not due to the said Richardson patents nor belonged to the same, and at no time did the defendants invade or interfere with any of the undertakings of the complainants.

On the contrary, the defendants say that they were making and selling the Crosby safety-valves, such as are considered in this case, long before the organization of the complainant corporation and their entry into the valve business, and at that time they had held exclusively the market for several years; that thereafter they learned of the said complainants' attempts to compete with them, both in style and quality of the safety-valve made and in price and terms of business dealing, and popular favor was sought by imitation of defendants' products and by reduction of prices.

B. F. THURSTON AND
J. H. MILLETT,
Of Counsel and Solicitors for Defendants.

170 Nos. 1184 and 1199.

Defendants' Amended and Additional Discharge. (*Filed Feb.* 9, 1887.)

And now come the defendants and ask leave to amend their discharge filed in said causes in the proceedings before the master Oct. 24, 1885, by striking out paragraph 6 therein and substituting the following, namely:

"6. That the valves made and sold by the defendants contain the inventions and improvements described in letters patent to George H. Crosby belonging to them, and divers other means and devices well known and open to the public at the time said valves were made and at the time of said Richardson's inventions, and that the whole sum which the master shall find as the profits which have accrued to the defendants, after deducting all proper sums for bad debts, expenses,

etc., is due wholly to the said inventions, improvements, and devices, and none whatever is due to the embodiment of the inventions described in the Richardson patents in said Crosby valves, unless it is merely nominal."

And the defendants, in further discharge of the complainants' charge, modified charge, and additional charge, aver that they have not wantonly infringed the Richardson patents sued on in this cause, but they manufactured and sold the Crosby valves herein accounted for to the master under the Crosby patents, as fully appears in the defendants' answer filed at the rules, and they believed that they were rightfully making and selling such valves and were not violating the rights of any person whatever.

And defendants further aver that when these suits were instituted they had been making and selling Crosby valves like those accounted for herein for nearly four years, to wit, from 1875 to 1879, and had openly, honorably, and very successfully introduced them into use, and at great expenditure of capital; that all this had been done with the knowledge, acquiescence, and encouragement of George W. Richardson, the patentee named in the said Richardson patents, during which time, for three years or more, they held business relations with him.

171 And the defendants further aver that in 1879 the complainant company was organized, the certificate thereof bearing date Feb. 10, 1879, and that said George W. Richardson was one of the corporators and directors, and who was also the superintendent of the company and had charge of the manufacture of its products; and thereafter, to wit, Feb. 15, 1879, said Richardson, with others, conveyed to said complainant company all their rights and interests in said Richardson patents and all their rights to prosecute for all infringements of the same, "to be held and enjoyed * * * as fully and completely, in all respects, as the grantors could have done had not this assignment been made;" and said defendants aver that said complainants took said rights and interests in said Richardson patents subject to all the limitations and restrictions imposed on the same by said Richardson and with full knowledge of them.

And said defendants aver that the acquiescence of said complainants and their predecessors for so long a time in the making, selling, and using of Crosby valves by the defendants and the public deprives them of any profits which may be shown herein as accruing to the defendants and may be adjudged as due to the embodiment of the inventions described in the said Richardson patents.

For the defendants, B. F. THURSTON,
J. H. MILLETT,
Of Counsel.

FEB. 9, 1887.

Mr. Clarke gives notice that he shall object to the defence set up in the "amended and additional discharge" this day filed by defendants as matter of law as well as matter of fact.

Attest: JOHN G. STETSON, *Master.*

172 The following is the report of the "proceedings before the master" returned by the master into court and filed with his report:

173 Circuit Court of the United States, District of Massachusetts.
In Equity.

CONSOLIDATED SAFETY VALVE COMPANY
v.
CROSBY STEAM GAGE AND VALVE COMPANY. } No. 1184.

SAME
v.
SAME. } No. 1199.

Proceedings Before the Master.

Present: T. W. Clarke, Esq., of counsel for complainants; J. H. Millett, Esq., of counsel for defendants.

Examination of George H. Eager.

BOSTON, *June* 29, 1885.

Examination by Mr. CLARKE:

My name is George H. Eager, and I am treasurer of the Crosby Steam Gage and Valve Company. This account was made up under my supervision, and I have compared it with my books.

Int. 1. Turning now to Schedule 2, memorandum of costs in No. 1184, do you know, of your own knowledge, how those costs were made up?

Ans. This schedule covers material and labor, and I do not know absolutely how those sums were obtained.

Int. 2. Turning now to Schedule 3, there are on this schedule two items of losses, one for bad debts and one for valves returned. Have you made a list of the bad debts and of the valves returned and whom they were returned by?

174 Ans. I have.

Int. 3. Please furnish those lists.

Ans. I will do so. I have them with me. I produce them. These lists contain a little more than Mr. Clarke calls for.

Int. 4. Do these lists apply to the account in 1199 as well as in 1184?

Ans. Yes.

Int. 5. On these lists I notice three columns of charges, one "Returned," one "Commission and discount," and one "Profit and loss account." Does the profit and loss account apply to what is called in Schedule 3 "bad debts"?

Ans. Yes.

Int. 6. The column "Commission and discount" applies to column 8 in Schedule 4, does it not?

Ans. It does, and includes both cases.

Int. 7. What items are included in the "General expenses," so called, in Schedule 3 in the two cases?

Ans. Rent, taxes, insurance, salaries, traveling expenses, coal, gas, water, teaming, advertising, printing, stationery, etc., wood cuts, engineer and watchman, depreciation of assets, small supplies, commissions. As to commissions, they amount to but little and are not to be confounded with those named on the lists.

Int. 8. Now, there are certain percentages marked against the general expenses of each year. What do those refer to?

Ans. They refer to the proportion which the sales of valves bear to the total sales.

Int. 9. You took, then, that fraction of your whole general expenses which was represented by the fraction which the volume of valve business was of the whole business in money, did you not?

Ans. Yes, sir.

Int. 10. In your regular accounts were the items which appear in Schedule 4 kept separate for the valve business or were they included in the general expenses of the company?

Ans. In part, both; but largely not separately.

Int. 11. Now the salary and expenses of Mr. Boyden, from Jan. 1, 1883, to Sept. 25, 1883, are charged at $1,096.81, and the salary and expenses of the same person during the period from Feb.
175 15, 1879, to Jan. 31, 1885, are charged at $1,479.71, as appears by account now filed. How long did you have Mr. Boyden in your employ and at what salary?

Ans. From Jan. 1, 1883, to Jan. 1, 1884, at $1,500 per annum.

Int. 12. What was his employment during that period?

Ans. To travel principally among railroads for the introduction of valves and gauges, our general goods. Mr. Boyden was selected for his fitness among railroads and especially with relation to our valve. He was the first man who tried it and proved it. He was a master mechanic and knew railroad men.

Int. 13. Was not his principal employment during that period the introduction of the chime whistle?

Ans. It was not.

Int. 14. You are quite certain of that?

Ans. I am.

Int. 15. Why, when from May, 1882, to May, 1883, your volume of valve business was thirty-five and one-fourth per cent. of your whole business, and from May, 1883, to September, 1883, the comparative volume was thirty-seven per cent., and from September, 1883, to May, 1884, the comparative volume was twenty-nine per cent., did you charge fifty per cent. of the cost of this general salesman to the valve business in this account?

Ans. It had no reference to the percentage whatever. Half of his expenses were deemed equitable and just by ourselves, to be charged to the valve business as the results of his labors, without regard to the volume of business. The results of his labors were not considered in apportioning it in that way. We considered that we should charge one-half Boyden's expenses directly to valves.

Int. 16. When you paid Mr. Boyden's expenses and salary and

charged it up on your books to what other part of your business was the rest of his salary and expenses charged?

Ans. That would imply that his half was charged to valves, which was not the case. In my former answer I said that part was charged to valves and part to general expenses. This account has been made up since the decree, from data which we had.

Int. 17. Then Mr. Boyden's salary and expenses originally
176 was charged without apportionment to the general expenses of the business, was it?

Ans. Yes, sir.

Int. 18. Now give me any facts that appear upon your books which justified you in charging more of Mr. Boyden's salary and expenses to valves than to other parts of the business.

Ans. I don't know of anything but the character of his orders and his labors as shown by his letters, etc.

Int. 19. Give me any of those facts in full which you characterize as the character of his orders and those representations of his in full which you characterize as his letters which make a justification of this fifty per cent. charge.

Ans. I cannot at this time give any. I haven't them here.

Int. 20. You charge here one-half of the salary of George H. Crosby. What was Mr. Crosby's employment?

Ans. Chiefly in experimenting with and perfecting his valve.

Int. 21. What was his salary during the period of the accounting?

Ans. From May 1, 1880, onward it was $3,000, and previous to that about $2,000 per annum.

Int. 22. You charge four hundred and four levers for locomotive valves. What were those levers?

Ans. They were plain iron levers for opening the valves.

Int. 23. Do not all your valves have levers for opening them?

Ans. Not all locomotive valves.

Int. 24. How does it happen that these levers cost more than one dollar apiece?

Ans. I don't know.

Int. 25. Do you make a different price for valves with levers and without?

Ans. I am not certain about that.

Int. 26. What are the perforated caps charged in this account, and on what sort of valves were they used?

Ans. They were brass caps, perforated, as their name implies, like a pepper-box, and used on some locomotive and other brass valves.

Int. 27. On more than one size of valve?

177 Ans. I think I may say yes, because on locomotives they make different sizes. We also put some on some small valves to a limited extent. I know we were prepared to make different sizes.

Int. 28. Do the different sizes of perforated caps cost any different price?

Ans. I couldn't say anything about the cost of the different sizes, material, and labor.

Int. 29. What is the article marked in Schedule 4 "Levers, Meady's patent"?

Ans. It is a lever made under Meady's patent, employing a set-screw to work it.

Int. 30. Did you pay Meady a royalty for that or did you buy his patent?

Ans. We bought his patent.

Int. 31. When did you buy his patent?

Ans. I couldn't state the date precisely now.

Int. 32. About what time?

Ans. To the best of my judgment, it was about January, 1883.

Int. 33. Is any part of the cost of that patent charged in the $842.40 in Schedule 4 of 1199?

Ans. Not directly.

Int. 34. Well, in what way "not directly" is any part embodied?

Ans. Possibly in computing the cost of the lever it may have been employed, but not to my knowledge, because I did not compute the price. I will correct. I did have something to do with making the price.

Int. 35. Well, what part of the charge of $842.40 was for labor and material and what part for other elements of cost than labor and material?

Ans. I couldn't state definitely.

Int. 36. State indefinitely, as near as you can.

Ans. I couldn't state indefinitely in figures.

Int. 37. I don't care particularly about figures. I should like it in words.

Ans. Mr. Meady and myself took the matter into consideration and fixed upon a schedule of prices that we thought proper and just.

178 Int. 38. What elements and what was the value of each element of the matter that you took into consideration in making up the price that you thought to be just?

Ans. I will say for myself that I had in mind that it took labor and material, the amount of which I relied upon Mr. Meady's judgment. I thought some part of the value of the lever was due to its being patented. I can't divide them.

Int. 39. Produce from your books any items that relate to the cost of the Meady lever.

Ans. I couldn't at this moment. We fixed upon certain prices for certain size valves and the $842.40 is found by computation from the number of levers, but the making of the price for each size lever was fixed by Mr. Meady and myself.

Int. 40. What are these Meady levers made of, iron or brass?

Ans. Iron.

Int. 41. Have they been put upon a considerable portion of valves?

Ans. Yes.

Int. 42. In the schedule of cost of valves that you have rendered is the cost of the iron of which the Meady lever is made included?

Ans. It is not.

Int. 43. Produce the items from your books which show the cost of the iron from which the Meady levers were made.

Ans. I cannot at this moment.

Int. 44. Is the cost of the labor and fuel for shaping the Meady levers included in the cost of the valves to which the Meady levers were applied?

Ans. It is not.

Int. 45. Produce the items from your books which show you what the cost of that labor and fuel was for shaping the Meady lever.

Ans. I cannot at present. It could be easily obtained, I think, from weight of levers, etc.

Int. 45½. Did you keep a separate account in your books of the material and labor for making the Meady levers?

Ans. We did not.

179 Int. 46. Did you keep an account in your books of the material employed in making valves?

Ans. Not on the account books.

Int. 47. Did you keep a separate account in your books of the labor employed in making valves?

Ans. Not in the office.

Int. 48. Did you at any time furnish to your salesmen, in order to assist them in making prices or allowing discounts or for any other reason, a schedule or memorandum of the estimated cost of valves?

Ans. We did not.

Int. 49. Did you, from 1879 to 1885, make for use in fixing prices and discounts any estimate or calculation of the cost of your safety-valve?

Ans. I think such costs were made, but I never saw them.

Int. 50. Who made them, if you know, or as you think?

Ans. I always supposed the knowledge of the cost of safety-valves was confined to Mr. Crosby, and so of all other goods.

Int. 51. From February, 1879, to Jan. 31, 1885, what was the capital of the Crosby Steam Gage and Valve Company?

(Objected to. Admitted.)

Ans. Feb. 15, 1879, it was $30,000; Jan. 31, 1885, it was $100,000.

Int. 52. When was the advance made from the capital stock of $30,000 to capital stock of $100,000?

(Objected to. Admitted.)

Ans. I couldn't say just this moment.

Int. 53. Can you give us the year?

Ans. I couldn't, to be certain. I think in 1881 or 1882; I think 1882.

(Ints. 54 and 55 and answers omitted by agreement of counsel.)

Int. 56. During the period of this accounting were any of the valves reported in the account sold in conjunction with other goods at a price named to the customer for the combined lot, as, for instance, valves and gauges together?

Ans. There were.

Int. 57. Are those goods separated in prices on your books?

180 Ans. Sometimes they are not. I don't know but generally. The price was sometimes named for a set, a valve and gauge.

Int. 58. In stating the price of valves in the instances where sets of valve and gauge were sold, how did you ascertain the proper price to charge for a valve in this account?

Ans. There might be something in the nature of the contract that would guide us, but in some cases we divided it equally.

Int. 59. In what cases did you divide it equally?

Ans. I don't know that I could say without reference to the sales book.

Int. 60. Produce any contracts for valves and gauges which give you a guide to any other than an equal division of prices between the two.

Ans. I meant by contract the verbal agreement or letter, as the case might be. I don't know that we have a contract, but we have a statement under which the trade is made. It must take some form or we wouldn't know how we stood. It may be a letter or an order from a salesman or a letter from a customer to send so and so.

Int. 61. The cases in which you sold a valve and a gauge together were, in most instances, cases in which you sold an inch and a quarter valve?

Ans. Yes.

Int. 62. And the gauge which you sold with it was usually an iron-case Crosby gauge?

Ans. Yes, generally 4½ inch; sometimes 5½.

Int. 63. Now, as to the sort of the two elements of the set, which cost most, the valve or the gauge?

(Objected to. Admitted.)

Ans. I couldn't say from my knowledge.

Int. 64. Please produce the items from your books from which you made up item 1 of Schedule 4 in the two accounts, cost of patterns made for valve and parts.

Ans. The only item directly from our books was the proportion that valve patterns has to the total patterns—that is, of all our business as per inventory. We proceed from that in a way that we thought was equitable to find what valve patterns cost per year.

Int. 65. Do you have a pattern-maker?

181 Ans. We do.

Int. 66. Do you keep a separate account of patterns?

Ans. We have what we call a pattern book, in which a pattern when it is made is set down—the cost of it. That is in the factory, kept by the foreman and the pattern-maker.

Int. 67. In your regular accounts, where are the charges for the pattern-maker's pay carried?

Ans. Pay-roll.

Int. 68. Is the pay-roll charged to expense account?

Ans. It is not.

Int. 69. What is it charged to?

Ans. Charged to manufacturing account.

Int. 70. What else in your regular accounts is charged to manufacturing?

(Objected to because the interrogatory is not limited to the valves in suit. Admitted.)

Ans. I can tell some things. Material and labor and pay-roll and metals, water, and gas.

Int. 71. Fuel?

Ans. Yes.

Int. 72. Anything else?

Ans. I will furnish a list to-morrow.

Int. 73. You have mentioned as one of the items of general expenses depreciation of assets. Please give me the amount of depreciation of assets as it appears in your books for each year of this account.

Ans.

From Feb. 15, 1879 to May 1, 1880	$2,859 82
May 1, 1880, to May 1, 1881	7,328 07
May 1, 1881, to May 1, 1882	916 46
May 1, 1882, to May 1, 1883	4,257 83
May 1, 1883, to Sept. 25, 1883	1,087 57
Sept. 25, 1883, to May 1, 1884	1,605 19
May 1, 1884, to Jan. 31, 1885	1,466 83

Int. 74. How did you ascertain those depreciations?

Ans. They are made from year to year as we made up our yearly accounts. In some cases on our machinery we made a five per cent. reduction. On some other things we made a greater reduc-
182 tion. That was the only way we could keep some things at a proper amount.

Int. 75. You charged your machinery at its cost and each year made a percentage of depreciation on the price as it stood on your books?

Ans. That was done sometimes. I don't mean to say that it was done regularly. I think on machinery we have made two reductions of five per cent.

Int. 76. Now, besides machinery what other assets were depreciated?

Ans. Fixtures, patterns, machinery and tools, wood cuts and electrotypes, patent rights.

Int. 77. Now, the wood cuts and electrotypes appear in your general expenses, don't they?

Ans. That term is in there, sir.

Int. 78. And the charge for wood cuts and electrotypes which appears in your general expenses is the cost of those things for the year, isn't it?

Ans. Yes, sir.

Int. 79. The cost of patterns that you have charged is the cost of patterns for making valves, isn't it?

Ans. Yes, sir.

Int. 80. Will you please tell me, if you have charged in expenses the whole cost of wood cuts, electrotypes, and patterns, why

should you charge each year for the privilege of partly wearing them out?

Ans. We haven't. Patterns shouldn't be there.

Int. 81. Will you produce a schedule of the items you have charged for general expenses during this period from Feb. 15, 1879, to Jan. 31, 1885?

Ans. Yes; I produce such schedule.

(Schedule produced is marked "General Expense Account, J. G. S., master.")

Int. 82. Under the item of advertisements is anything included except the bills of newspapers?

Ans. Magazines, directories, etc.

Int. 83. But nothing for cuts or circulars?

183 Ans. No.

Int. 84. Under the item for printing, stationery, etc., what was included?

Ans. Catalogues, circulars, office stationery, account books, etc.

Int. 85. Please state in detail what is included under the head of "wood cuts and electrotypes."

Ans. Wood cuts of our products and electrotypes of the same.

Int. 86. The items that are found in the item of "wood cuts and electrotypes" include all the wood cuts and electrotypes that you had made for you during the years included on this account; is that so?

Ans. Will answer this in the morning.

Int. 87. What are included in the item of "small supplies," which seems to have annexed to it some pretty large sums?

Ans. Paper and twine, nails and common screws, tags, paste and brushes, excelsior, sawdust, brooms and brushes, oil, waste, emery, emery cloth, sand paper, drillings, rouge, tripoli, alcohol, naphtha, bronze powder, paint, lacquer varnish, brushes, etc., belt lacings, tacks and cement, files, drills, marking letters, type, dies, etc., telephones and telegrams, expressages, postage stamps, donations, carpenter, mason, and plumbing repairs, auditor city cartage of ashes, collections, ice, etc., etc., etc.

(Accounts of valves returned, etc., 4 papers, marked for identification "Accounts of Valves Returned, Nos. 1, 2, 3, and 4, J. G. S., ex'r.")

(Adjourned.)

JUNE 30, 1885.

(Mr. EAGER continues:)

In answer to Int. 86 I now say that that is so.

In response to Int. 72 I now put in some other things—freight and teaming, express and telegraphs, and rent of factory. There are other things that go in there that are partial. Rent goes part to expense of office and part to manufacture. It is a mere arbitrary division for convenience of book-keeping.

Int. 88. In the schedule of "valves returned, commissions, extra

Ans. Charged to manufacturing account.

Int. 70. What else in your regular accounts is charged to manufacturing?

(Objected to because the interrogatory is not limited to the valves in suit. Admitted.)

Ans. I can tell some things. Material and labor and pay-roll and metals, water, and gas.

Int. 71. Fuel?

Ans. Yes.

Int. 72. Anything else?

Ans. I will furnish a list to-morrow.

Int. 73. You have mentioned as one of the items of general expenses depreciation of assets. Please give me the amount of depreciation of assets as it appears in your books for each year of this account.

Ans. From Feb. 15, 1879 to May 1, 1880 ..... $2,859 82
May 1, 1880, to May 1, 1881 ..... 7,328 07
May 1, 1881, to May 1, 1882 ..... 916 46
May 1, 1882, to May 1, 1883 ..... 4,257 83
May 1, 1883, to Sept. 25, 1883 ..... 1,087 57
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May 1, 1884, to Jan. 31, 1885 ..... 1,466 83

Int. 74. How did you ascertain those depreciations?

Ans. They are made from year to year as we made up our yearly accounts. In some cases on our machinery we made a five per cent. reduction. On some other things we made a greater reduc-
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Int. 75. You charged your machinery at its cost and each year made a percentage of depreciation on the price as it stood on your books?

Ans. That was done sometimes. I don't mean to say that it was done regularly. I think on machinery we have made two reductions of five per cent.

Int. 76. Now, besides machinery what other assets were depreciated?

Ans. Fixtures, patterns, machinery and tools, wood cuts and electrotypes, patent rights.

Int. 77. Now, the wood cuts and electrotypes appear in your general expenses, don't they?

Ans. That term is in there, sir.

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Ans. Yes, sir.

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Ans. Yes, sir.

Int. 80. Will you please tell me, if you have charged in expenses the whole cost of wood cuts, electrotypes, and patterns, why

should you charge each year for the privilege of partly wearing them out?

Ans. We haven't. Patterns shouldn't be there.

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Int. 85. Please state in detail what is included under the head of "wood cuts and electrotypes."

Ans. Wood cuts of our products and electrotypes of the same.

Int. 86. The items that are found in the item of "wood cuts and electrotypes" include all the wood cuts and electrotypes that you had made for you during the years included on this account; is that so?

Ans. Will answer this in the morning.

Int. 87. What are included in the item of "small supplies," which seems to have annexed to it some pretty large sums?

Ans. Paper and twine, nails and common screws, tags, paste and brushes, excelsior, sawdust, brooms and brushes, oil, waste, emery, emery cloth, sand paper, drillings, rouge, tripoli, alcohol, naphtha, bronze powder, paint, lacquer varnish, brushes, etc., belt lacings, tacks and cement, files, drills, marking letters, type, dies, etc., telephones and telegrams, expressages, postage stamps, donations, carpenter, mason, and plumbing repairs, auditor city cartage of ashes, collections, ice, etc., etc., etc.

(Accounts of valves returned, etc., 4 papers, marked for identification "Accounts of Valves Returned, Nos. 1, 2, 3, and 4, J. G. S., ex'r.")

(Adjourned.)

JUNE 30, 1885.

(Mr. EAGER continues:)

In answer to Int. 86 I now say that that is so.

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Int. 88. In the schedule of "valves returned, commissions, extra

discounts and losses sustained on account of sales as taken from the journal" the column headed "To P. & L. account" is the column which relates to the "losses sustained"?

184 Ans. This column head- "To P. & L. account" represents what has been passed to profit and loss.

Int. 89. Now, what accounts are the accounts in the schedule which are referred to in the heading by "losses sustained on account of sales"?

Ans. While I didn't write that heading, from my understanding of it I believe losses sustained apply to the P. & L. column.

Int. 90. Who are Cady, Glassbrook & Co., to whom you sold three one and one-fourth inch valves July 29, 1880, which were charged to P. & L. account in Aug. 1, 1880?

(Objected to because upon mere inquiry as to profits the witness is not required to identify and locate name of persons and firms appearing in the statement made. Objection overruled.)

Ans. I don't know them personally. I can't state their location. It is a long time ago. I understand they have failed.

Int. 91. On Dec. 6, 1879, you state in the "schedule of pop valves returned, etc.," that you sold a valve to the Pittsburg, Fort Wayne and Chicago railroad. Does that appear on your account of sales?

Ans. I do not find it.

Int. 92. That valve was not charged to P. & L. because the purchaser failed, was it?

Ans. No, sir.

Int. 93. For what reason was it so charged?

Ans. The valve was lost—the trace of it—through some change of mechanics. It was originally sent on trial, and after several unsuccessful searches for it it was given up and charged as lost.

Int. 94. Do you find the charge of the two-inch valve to the Portland Machine Works on your account of sales which appears on the P. & L. account?

Ans. I do not find it.

Int. 95. What was the reason for charging the Portland Machine Works valve off?

Ans. Inability to collect the bill. I understood they failed. I know their draft or note was protested.

Int. 96. What was the reason for charging off the St. Paul and Duluth Railroad Company valves?

185 Ans. They were sent as samples and lost and could not be found. My impression of that is the same as in the other case of lost valve.

Int. 97. What was the reason of charging off the valves of the Yale Lock Company?

Ans. That charge there is for extraordinary expense, as maintaining the efficiency of those valves.

Int. 98. Do you find the charge of the sale of those valves to the Yale Lock Company?

Ans. I do not.

Int. 99. What was the reason of charging off the valve to J. A. Haish?

Ans. I think it should be J. H. Hinch. I think he is a man in Meredith, who failed.

Int. 100. What was the reason of charging off the valves of the Virginia Midland railway?

Ans. I couldn't state positively. I haven't examined the account quite so far as that. I can give you the reason later.

Int. 101. What was the reason of charging off the Waterhouse valves.

Ans. They have suffered two depreciations of fifty per cent., and the account is considered worthless.

Int. 102. What was the reason of charging off the Lansing Iron Works valve?

Ans. I couldn't state definitely.

Ans. 103. What was the reason of charging off the valves of the Alleghany Valley railroad?

Ans. I couldn't state definitely.

Int. 104. What was the reason for charging off the Cumberland Valley railroad valve?

Ans. I cannot state definitely at this moment.

Int. 105. Do you find that valve charged in the sales account?

Ans. I do not.

Int. 106. What was the reason for charging off the Lehigh Valley railroad valve?

Ans. I couldn't state definitely.

186 Int. 107. Do you find that valve charged in your sales account?

Ans. I do not.

Int. 108. Why was a special commission or discount allowed to the Chicago, Rock Island and Pacific railroad?

Ans. They were billed at $25, and they should have been at $22.50, as our salesman had quoted. It was an error in billing.

Int. 109. Does that same correction of an erroneous charge by a credit in column of discounts and commissions apply to the valves of the Western Union line, Central Railroad and Banking Company, M., K. and T. railroad, Chicago, St. Paul, Minneapolis and Omaha railroad, M. M. Buck & Co., and any other and what items in these accounts?

Ans. As to the Western Union line, they were billed at $25, and should have been at $22.50; same as to M., K., and T.; same as to Central Railroad and Banking Company; same as to Chicago, St. Paul, Minneapolis and Omaha railroad. I can't say positively as to M. Buck & Co. I could pick out the others in time.

Int. 110. Please take time for this, and also explain the reasons of the special discount charges made in this account; and also, as we have found that several sales have been omitted from the account of sales of valves borne on these allowance schedules, please

see if the valves referred to in these schedules are borne on the schedules of sales.

(Adjourned.)

(The following answer is furnished in writing by Mr. Eager:)

Ans. Item. 1. Was sent out on trial. Returned.

Item 2. The original sale of these valves was found to be prior to Feb. 15, 1879.

Items 3, 6, and 7. Are to correct errors in price.

Items 5 and 4. Returned.

Item 8. Should be 4 1½" valves instead of 1 2½".

Item 9. Original sale found to be prior to Feb. 15, 1879.

As to that portion of question calling for the reasons for the special discount charges I reply, following the order of the numbers enumerating the items of these schedules (in red on left margin):

Items numbered 3, 6, 15, and 52 I have already explained.

Item 14. My answer to question relating to this I have
187 found was incorrect. These valves were first sold to Cady, Glassbrook & Co. and afterwards transferred to Lansing Iron Works in sales (see p. 58 of sheets).

Item 16. Was commission paid to Wm. Cook for valve sold to L. Wright, Jr.

Items 19, 21, 30, 31, 32, 33, 34, 38, 42, 43, 47, 55, 56, 61, 62, 64, 66, 67, 72, 75, 76, 77, 79, 81, 82, 84, 87, 89, 90, 91, 92, 99, 101, 104, 106, 107, 117, 118, 121, 122, 140, 141, 143, 144, 148, 202, 203, 203 A, 204, 215, 218, 221, 223, 224, 225, 226, 227, 228, 232, 233, 234, 243, 250, 251, 253, 256, 271, 272, 295, 296, 297, 300, 302, and 312*a* are allowances for errors in prices as charged.

Item 22. Already explained.

Item 37. Commission paid for valve sold to Hudson River Pulp Company (p. 66 of sheets).

As to item 13, I find that owing to a clerical error the 2" valve was omitted from the sheets.

Item 71 was sent out as a sample and lost trace of by railroad employés. This was also the case with 178, lost at Hanover Junction, and 179, lost at Scranton.

Item 73. These valves were sold to H. B. Beach & Son for the Yale Lock Company, and the charge was for putting on the valves and adapting them to the peculiar conditions required.

Item 115. Is to correct error in charge. Two valves were sold, and the price extended for three.

Items 51, 108, 113, 114, 116, 129, 130, 131, 152, 164, 166, 169, 208, 209, 211, 213, 214, 244, 257, 259, 260, 298, 299, and 318 are allowances to adjust and settle accounts.

Item 70. Parties failed.

Items 172, 173, 174, 175, 180, 194, and 246 are uncollectible from the last-named or other cause.

Item 177. One-half this charge or $25.00 should be deducted, as not pertaining to valves.

Items 151 and 154. Should be deducted here and placed in "1199" account.

Item 216. Is for allowance for error in price. This is not found on sheets. Should go in March 14, 1884.

Item 255. Returned. Fifteen (15) dollars of this for one
188 2½" valve should go in the "1184" account, where the sale will be found — Aug. 31, 1883.

Item 310. Returned. In the sheets 12 valves are entered as 1¼" when they should have been 1½".

Item 229. Commission on 6 valves sold Washburn Iron Works.

Item 150. Commission on 5" valve sold to Wattomsac Paper Co.

Items 125, 126, 127, and 128. Commission to P. & L. on valves sold to Risdon Iron Works.

Item 145. For freight on valves. Paid to satisfy demand of Risdon Iron Works.

Item 197. Only parts of valves furnished.

Item 242. Allowance made to settle account and should be $11.50 instead of $7.70 as here shown.

Item 245. Bad debt. This should be in "1184" account, and should be $37.50 instead of $41.25.

Item 247. Returned. This should be in "1184" account, and does not belong in P. & L. column. The amount should be $50.00, and not $34.50 as here shown.

Item 248. Extraordinary expense in furnishing new springs, etc., to three 4" valves.

Item 276. Charge by the customer for work done on valves by him and allowed by us.

Item 277. Returned from Central Falls Boiler Works.

Item 279. Extraordinary expense on valves.

Item 280. Extraordinary expense in fixing valves. Charged by the customer and allowed by us.

Item 292. Expressage on defective valves.

Item 315. Expense of sending out and returning valve.

Item 317. This is not sustained and should be taken out.

Item 330. Money paid Frick & Co. for advertisement in their catalogue. This is not in general expense.

Item 273. Is in general expense and should be taken out here.

Item 235. Commission to H. A. Rogers on valves sold Harrisburg Car Mfg. Co.

Item 249. Commissions paid on cash sales of valve. (This cash sale will appear on supplemental sheet.)

Items 201 and 258. Commissions on sales of valves.

189 Items 282, 283, 284, 285, and 286. Commissions on sales of valves.

Item 195. Commission to D. Stevenson on valve sold to D. V. Ahl (p. 34, sheets).

Items 176 and 263 are found not to pertain to valves; also item 317.

Items 10, 11, 17, 18, 20, 23, 24, 25, 26, 27, 28, 29, 35, 36, 39, 40, 41, 44, 45, 46, 48, 49, 50, 53, 54, 57, 58, 59, 60, 63, 65, 68, 69, 74, 78, 80 (this should be 4"), 83, 85, 86, 88, 93, 94, 95, 96, 97, 98, 100, 102, 103,

105, 109, 110, 111, 112, 119, 120, 123, 124, 132, 133, 134, 135, 136, 137, 138, 139, 142, 146, 147, 149, 153, 155, 156, 157, 158, 159, 160, 161, 162, 163, 165, 167, 168, 170, 171, 181, 182, 183. 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 198, 199, 200, 205, 206, 207, 210, 212, 217, 219, 220, 222, 230, 231, 236, 237, 238, 239, 240, 241, 254, 261, 262, 264, 265, 266, 267, 268, 269, 270, 274, 275, 278, 281, 287, 288, 289, 290, 291, 293, 294, 301, 303. 304, 305, 306, 307, 308, 309, 311, 312, 313, 314, 316, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 331, 332, 333 are for valves returned for various causes.

Item 252. Discount on two special marine valves.

These valves cost seventy-three dollars and fifty-five cents each, exclusive of patterns, and the difference between the cost of these valves and the ordinary 4″ valve of this period should be added to costs of valves as shown in the account. Eleven dollars of this item is to correct an error in sales of Jan. 16, 1885, when two 2″ valves are billed at the price of 2½″ valves.

The red column of numbers, on right margin of schedules, indicates the pages of sheets upon which the sales of the valves referred to are borne, and all are found excepting items 2, 9, 22, 216, 220.

Item 305. We expect to be able to explain this more fully.

Items 318 and 323. Should be taken out here and put in "1199" schedules.

JULY 2, 1885.

Int. 111. Am I correct in supposing that during the period of the accounts rendered the valve business conducted by your corporation was, in your system of accounts, mingled with the other business of the corporation?

190 (Objected to as asking for the correctness of a supposition when the testimony already shows that the valves, the profits of which are sought, were charged separately as things sold and have been accounted for as separate things made by the defendants, as well as the cost of their construction. Interrogatory as put excluded.)

Int. 112. Will you produce your books showing in any place for any period of statement the account of valves which you have rendered in the form in which you have rendered it?

Ans. We will produce our books and answer any question directed to the determination of the sales and costs of the valves made during the period of the accounting.

Int. 113. Have you on your books in any form the statement of costs made on the Schedule 2 of these accounts in the form in which they are presented?

Ans. We have not.

Int. 114. Have you on your books a statement of the general expense account of Schedule 3 in the form there presented?

Ans. We have not.

Int. 115. Have you on your books a statement of the general expense account in the form here presented in Schedule 3 and including the items you have testified are included in these accounts, but having the footings in the ratio of one hundred per cent. to the

percentages given in the percentage column of the general expense account?

Ans. No. The heading "General expenses" in Schedule 3 is merely a designation of the expenses in the business of the company which apply generally and not specially, as designated in Statement 4, to the making of the valve.

Int. 116. The items footed up from which to take the percentages charged in the general expense account rendered appear on your books in two accounts headed "Manufacturing" and "General expenses," do they not?

(Objected to as an inquiry into the system of book-keeping of the defendants' business, the greater part of which is independent and of a private character, so far as this accounting is concerned, and not pertinent nor admissible for the purpose merely of getting at the profits sought and for which the defendants already
191 have offered to answer any question from their books which is pertinent for such purpose, but do deny the right to be required to answer merely inquisitorial questions tending to discover other and private transactions; and, claiming this to be of such character, the defendants decline to answer.)

Int. 117. You have stated that the sales of valves bore the percentages marked against them in the schedules of general expenses to the total sales of your company. Have you any account on your books in which is stated, for the periods named in the accounting, the total sales; and, if so, what is it?

Ans. We have no sales account, designated as such.

* * * * * * *

Int. 120. You have, then, no account on your books, the footings of which show the gross sales in each year, have you?

Ans. We can furnish the total sales from our books.

* * * * * * *

Int. 122. On the 25th of September, 1883, did you have any safety-valves on hand of the kind reported in the account; and, if so, how many and of what sizes?

Ans. I couldn't state from any knowledge.

Int. 123. On the 31st of January, 1885, did you have any valves of the kind mentioned in the account on hand; and, if so, of what sizes?

Ans. We had valves in process, but what numbers or sizes I couldn't state.

* * * * * * *

Int. 126. Is there any account on your books in which, either for special periods or for the whole period, there is stated a summary of the valve business, showing its profits substantially in the form of the summary presented in the accounts?

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* * * Lines of stars above indicate ints. and answers omitted by agreement of counsel.

(Defendants object to that portion of the question as goes merely to the book-keeping or the accounts kept by the defendants. Answer suspended as to the objection.)

Ans. There is no summary such as presented.

* * * * * * *

Int. 128. Will you produce for examination each and every of the accounts of your business during the period of these
192 accountings into which any of the items of charges and credits in the accounts filed enter or appear on either side?

(Objected to so far as the question tends to seek information as to the transactions other than those of valves of the company in the accounts spoken of.)

Ans. We will produce every item which has contributed to the making up of the accounts submitted to the master.

(Ints. 129 to 133, inclusive, and answers omitted by agreement of counsel.)

(Adjourned.)

JULY 7, 1885.

Int. 134. When valves were consigned or sent out on trial, did you not make of those valves entries in a consignment account of some sort, instead of charging them as completed sales?

Ans. They were oftenest charged directly to the parties.

Int. 135. Did you not keep an account of the valves consigned or sent out on trial?

Ans. We did not. We had no consignment account.

Int. 137. Did you at any time during the period of these accounts make any inventory or account of stock of the valves on hand; and, if so, at what times?

Ans. We made inventories at the end of each year of material and stock on hand, in which may have been included a few valves like other things, though we seldom had any stock on hand.

Int. 138. Those inventories were taken as of April 30 of each year?

Ans. Yes.

Int. 139. Will you please produce a statement of the sizes, number of each size, and valuations of valves on hand, as specific as your books or accounts show, on thirtieth day of April, 1879, thirtieth day of April, 1880, thirtieth day of April, 1881, thirtieth day of April, 1882, thirtieth day of April, 1883, and thirtieth day of April, 1884?

Ans. It would be impossible; we will, if we can.

Int. 140. Have you not those inventories and accounts of stock taken at those times?

Ans. We might have some of them, but I doubt if we have
193 all. They were sometimes taken on sheets, and may have been destroyed. They were mere informal stock takings.

Int. 141. Were not the results of them entered upon your books for the year?

Ans. I presume the aggregates were.

Int. 142. Did you not keep, either on your books or on your files, the details from which you made up the aggregate of merchandise and stock on hand?

(Objected to unless expressly confined to the valve business. Question admitted.)

Ans. They were kept in some instances.

Int. 143. In what way was the valuation of the valves and parts of valves determined in making up the account of stock?

Ans. Just according to the judgment of the man who took it; it might be a clerk or a workman.

Int. 144. Did it have anything to do with the selling price?

Ans. Nothing whatever.

Int 145. Did it have anything to do with the cost?

Ans. I couldn't say; I guess not much.

Int. 146. Can you give me the name of the person or persons who made, in any year, the valuation of valves?

(Objected to; that the treasurer is not the detective to search for evidence for complainants. Excluded.)

Int. 147. Did you examine the valuations of valves made in these accounts of stock?

Ans. I did not.

Int. 148. To whom was the valuation of valves in any of the years of the accounting intrusted by the company?

(Objected to. Admitted.)

Ans. I couldn't say.

Int. 149. Can you find out?

(Objected to, as the treasurer is not a detective to obtain evidence for complainants. Excluded.)

Int. 150. Will you examine all the records, papers, and accounts of the company at the close of each fiscal year, in order to ascertain and inform me to what officers or employé of the company
194 the business of making the valuation of the valve stock on hand was intrusted?

Ans. No, sir.

(This answer was given by counsel.)

Int. 151. You are aware, Mr. Eager, that this is a personal responsibility that you are taking, and I repeat the former question to you, and desire your own answer.

(Objected to, and witness instructed to answer no; and counsel for defendants adds that, while the officers of the company are willing to give the information sought, they are unwilling to search for witnesses for complainants to be examined on this hearing.)

Ans. I will say that to my knowledge the taking of valves was intrusted to no particular person.

(Counsel for defendants withdraws his instruction and asks for ruling on the question. Question admitted.)

I know without searching that there is nothing to indicate who took the valuation of a single article.

Int. 152. Will you please produce all the books, accounts, papers, and memoranda in the possession of the company relating to the valuation of the valve stock on hand at the time of the close of each fiscal year for my examination?

Ans. No, sir; because they are all mixed up with other private matters of the company.

Int. 153. You refuse to produce, then, these accounts relating to valves, do you?

Ans. No, sir; not such as relate directly to valves.

Int. 154. Do you refuse to produce such of these papers that relate to valves, if anything else is contained in the papers?

Ans. That would depend upon what it was.

Int. 155. And you would expect me to take your judgment as to whether a paper partly relating to valves and partly to something else should have the valve part shown to me or not, would you?

Ans. I don't know at this minute anything that would prevent me from showing everything relating to valves.

Int. 156. Will you now tell me the total sales of your company as they appear on your books for each of the periods named in these accounts?

195 Ans. I will examine the books and produce such statement.

Int. 157. And please also tell me, at the time you produce it, on which of the accounts borne upon your books any column of figures is carried which foots up according to the amount which you shall give me. Will you do this?

Ans. I will give you the totals from our books of original entries which shall show the total sales of our company for the periods named, but, under instructions of counsel for the company, I will not name the accounts to which these footings may or may not have been afterwards carried.

(Adjourned.)

JULY 17, 1885.

Int. 158. Have you searched out and found and prepared the various documents and accounts which were inquired of when you were last examined?

Ans. I have answered Int. 110 in its place. I here produce a schedule showing total sales, marked "Exhibit Total Sales, J. G. S., master." I also produce a schedule showing valve stock on hand at various dates named, and the same is marked "Exhibit Valve Stock in Hand, J. G. S., master."

Int. 159. Can you give me the total payments for material purchased by the company for each of the periods of this accounting,

and the total payments for labor for each of the periods of this accounting, and also the total amounts of material unmanufactured at each of the periods of rest of this accounting; also the total amount of goods on hand and parts of goods in the process of manufacture at each of the periods of rest; also the total amount of this labor which went into valves during each of the periods of this accounting, and the total amount of material which went into valves during each period of the accounting, those amounts to be stated in gross values (if you prefer) without the details of weights and qualities of material or the time-roll of labor?

(Defendants object to that portion of the question relating to all the material purchased and all the labor expended and all the goods on hand.)

Mr. CLARKE: The complainants state that the defendants are engaged in a manufacturing enterprise in which certain raw
196 or partly manufactured materials are purchased, the forms of which are changed by labor put upon them and by industry bestowed upon them by the officers and servants of the company and by other expenditures made upon them under the supervision of the officers and for the assistance of the workmen, and finally these things, which have been by the aid of the labor and care bestowed upon them and the expense put into them converted from the condition of materials to the condition of goods, have been sold through the agency of officers of the company, which expenditures upon the materials to convert them into sold goods are of two classes: (1) hand labor actually employed in shaping the materials into the form of goods, which may be called the producing labor; and (2) general expenses, which include power and capital employed, and the non-producing labor essential to make the producing labor available as a marketable article.

The cost of goods and the profit to be derived from goods is one side of the account, the other side of which is the actual receipts from sales, being the gross price, with bad debts, commissions, and allowances deducted. General expenses are to be, in a proper statement of the account, added to the cost of goods and not deducted from the price.

As the valve account was not kept separately from the account of other portions of the business in order to separate it, and for this purpose only, these amounts are desired. The master is not desired at this time to rule finally that the complainants' proposed method of stating the account is the only correct method, but is desired to rule that complainants may have an opportunity to present the account stated in this form, and may have the materials for so presenting it.

Mr. MILLETT: Defendants call the master's attention to the expressed purpose of the complainants, which is to seek the costs of all defendants' products, with which to make a comparison of the costs of the valves accounted for in order to establish a rate per cent. upon which the distribution of the general expenses is to be made. The defendants urge that this theory for the distribution of

the general expenses is incorrect, and that evidence from the defendants is not admissible te establish that. The defendants call
197 the master's attention to the law, already settled, in relation to the distribution of general expenses, and cites the case of Hitchcock *v.* Tremaine, 9 Blatchford, 385.

MASTER: I have given the questions raised upon the question objection and statements of counsel such consideration as I am able and will state my conclusion.

To do this intelligently, it is necessary to consider the present condition of this accounting. The defendants have filed an account. The complainants have stated substantially that they are not satisfied with this account, and have desired an examination of the defendants' proper officers relating thereto and an examination of the books and accounts and other records of the defendants relating to the matter involved in the accounting. The objects of such a request in any accounting are, first, to ascertain if the account rendered is a correct account of profits in this particular—that it is made up upon correct principles; also, in this particular, that the several items which enter into the account are correctly stated; secondly, another object is to see if there is anything omitted in the account, and to ascertain if a charge may not be made against the account that it is not made out upon correct principles.

In this particular case it appears that the valve business of the defendants was, generally speaking, about a third of their entire business of manufacturing and selling. It appears also they kept no special account of cost of material or labor or of incidental expenses relating either to the manufacture or sale of valves. When they were ordered by the master to file an account they, for the first time, undertook to separate from their other business their valve business. Of course, some of the items relating to that business were very easily ascertainable, as, for example, the receipts from the sales of valves, because the sale of each valve could be picked out from the sales of other goods, and so the gross receipts from sales of valves could be made definite. Not so, however, with regard to the items of cost, as, for example, labor, which went into the product of these valves, because no special pay-roll had been kept showing the labor on valves. This item of labor could only be ascertained by some form of calculation. Now, it may be true that the form of calculation which the defendants have adopted is the correct form
198 and the one which will be finally adopted by the master and approved by the court. The complainants, however, are at liberty, in making up their charge against this account, to allege that the defendants' method of estimating labor is incorrect in its details or that the manner of calculating it is not the best manner of calculating cost of labor, and so to claim that another and different method of estimating cost of labor should be adopted by the master. The same is true with regard to various expenses. The master cannot determine at this stage how the account is to be finally determined. It is his duty now to secure for the complainants such examination of the defendants' books and such reason-

able explanations relating to those books as the defendants and their officers may be able to give.

I am of the opinion that, as the accounts of the defendants were kept, this officer of the defendants should inform complainants' counsel whether the books or other memoranda of the company enabled him to give the total payment for material purchased by the company for each of the periods of this accounting, and the total payments for labor for each of the periods of this accounting, and the total amounts of material manufactured at each of the periods of rest in this accounting, and the total amount of goods on hand and parts of goods in process of manufacture at each of the periods of rest, and the same items of information with relation to valves. The use to be made of this information is not a matter of concern at present.

Mr. MILLETT: Defendants except, not only to the ruling of the master as expressed, but so far as it may be implied to affect the defendants' position as to the theory of the distribution of the general expenses.

Ans. I think I can give the amounts of the pay-roll and, in time, of the materials purchased and stock on hand.

Int. 160. As this will be considerable trouble, would you prefer to do it yourself or by your clerks or to exhibit your books and let us find this information for ourselves?

Ans. I should prefer to do it myself.

Int. 161. Will you, then, please answer the inquiries suggested in Int. 159, not, of course, putting into the amount of materials
199 any of the items that go to make up the general expense account as you have made it up in this case?

(Same objection as to Int. 159.)

Ans. I will endeavor to.

Int. 162. Will you please give me for each of the periods covered by this account the salary list which you have included in your general expenses?

Ans. Yes; when I furnish the other statements.

Int. 163. Will you also inform me, concerning the persons drawing salaries for each of those periods, whether or not they were stockholders of the corporation and to what proportionate extent in each period they were such stockholders?

(Objected to so far as it calls for a list of the stockholders among those drawing salaries. Overruled. Counsel for defendants instructs treasurer not to answer.)

Int. 164. Will you also inform me concerning the services and all the services rendered by the persons borne on the salary list to the company in return for their salaries, and whether or not such services to the company occupied the whole time of the salaried person or whether such salaried person was engaged in any other business occupation?

Ans. Yes.

Int. 165. I notice in your account a charge for interest paid on

loan, which appears to be apportioned according to the receipts for goods. In what way was that loan employed—in manufacturing and purchase of material, or was it entirely devoted to payments which influenced the sale of goods after they were manufactured?

Ans. It was borrowed capital, for the general use of the company.

Int. 166. During the period of this accounting I notice that you give no credit for material received. Did you not have at any period of the accounting money on loan which drew interest?

Ans. Never loaned a cent to my knowledge.

Int. 167. Will you please examine, if you conveniently can, and tell me whether this item of interest (No. 212) is an item derived from the balance of your interest account or corresponds to the balance of your interest account?

Ans. No, sir; it is not the balance of interest account. It
200 is items in the interest account that we thought it fair for valves to share. We have made no use of the interest account as a whole.

(Adjourned.)

AUG. 1, 1885.

Int. 168. Have you prepared the answers to the questions put to you at your last examination which will give the total payments for material purchased by the company for each of the periods of this account, the total payments for labor for each of the periods of this account, and the total amounts of material unmanufactured at each of the periods of rest in this accounting, the total amount of goods on hand and parts of goods in process of manufacture at each of the periods of rest, also the total amount of that labor which went into valves during each of the periods of this accounting, and the total amount of material which went into valves during each period of this accounting, as required in Int. 159, and with the limitation that the items in the general expense account are not to be put in as materials; also the salary list for these various periods included in the general expense account, as required in Int. 162, and which of the persons on the salary list were stockholders, as required in Int. 163, and the duties and services of the salaried persons, as required in Int. 164?

Ans. In reply to the inquiries embraced in Int. 159 I desire to say that I am unable to ascertain and therefore cannot furnish the amount of materials purchased during the time of this accounting for valve stock only, and that the amounts given below represent the payments for materials purchased for the business of the company during the several periods given:

From Feb. 15, 1879, to May 1, 1880	$30,590 15
May 1, 1880, to May 1, 1881	35,221 48
May 1, 1881, to May 1, 1882	53,566 94
May 1, 1882, to May 1, 1883	55,759 55
May 1, 1883, to Sept. 25, 1883	21,492 55
Sept. 25, 1883, to May 1, 1884	30,545 07
May 1, 1884, to Jan. 31, 1885	26,810 49

The above amounts include to some extent purchases of small supplies for the factory, but these are so mingled with pur-
201 chases of other materials that it is impossible to separate them without the expenditure of a great amount of time and labor.

In answer to that portion of Int. 159 calling for the payments for labor, I would say that I am unable to ascertain the amount of the pay-roll applicable to the construction of valves only. The total amounts paid for labor for the periods of this account are given below.

In these amounts are embraced the wages or salaries of the foreman, A. C. Meads, and the engineer and watchman. The wages of the two latter may be found among the items in the "general expense" account already filed.

The pay-roll is as follows, viz:

From	Feb. 15, 1879, to May 1, 1880	$14,254 80
	May 1, 1880, to May 1, 1881	19,667 54
	May 1, 1881, to May 1, 1882	29,591 62
	May 1, 1882, to May 1, 1883	38,963 36
	May 1, 1883, to Sept. 25, 1883	16,718 00
	Sept. 25, 1883, to May 1, 1884	24,516 08
	May 1, 1884, to Jan. 31, 1885	28,655 21

To the further inquiry in Int. 159 touching the manufactured and unmanufactured materials and goods on hand at the periods of rest mentioned, I reply that the following statement shows it:

April 30,	1879	$5,564 49
" "	1880	7,778 73
" "	1881	14,390 39
" "	1882	23,352 55
" "	1883	28,085 79
" "	1884	33,870 96

(Printing of list showing salaries is omitted by consent.)

* * * * * * *

I desire to say that in making up this record of salaries I have discovered the fact that the foreman's salary (A. C. Meady) has, by a clerical error, been omitted from the "general expense" account during the period from Feb. 15, 1879, to Jan. 1, 1883, and that it should be added thereto as follows:

202	From Feb. 15, 1879, to May 1, 1880	$1,447 06
	From May 1, 1880, to May 1, 1881	1,459 76
From	May 1, 1881, to May 1, 1882	1,560 00
From	May 1, 1882, to Jan. 1, 1883	1,050 00
	Total	$5,516 82

I desire also to say that the item salaries, as shown on paper marked "general expense" in this account, includes only one-half the salary of Geo. H. Crosby and one-half the salary of Geo. E. Boyden; the other half of these persons' salaries is charged directly to valves.

The item traveling expense, as shown on paper marked "general expense," includes only one-half the traveling expenses of Geo. E. Boyden; the other half has been charged directly to valves.

To Int. 164. As to the services rendered by those persons whose names are on the salary list, I would say:

The president of this company has held that office, with the exception of a few weeks, since its organization. He is also engaged in the practice of law.

The treasurer has served in that capacity, with the exception of a few weeks, since June, 1878, and actively in the office of the company since Sept. 1, 1881, at which time he relinquished active participation in other business.

All other persons on the salary list have no other business occupation.

Int. 169. How much commission on sales did Mr. Crosby draw between Feb. 15, 1879, and May 1, 1879?

Ans. I don't recollect the exact amount; it couldn't be much; to the best of my recollection, $250.

Int. 170. And what rate of commission did he get on valves?

Ans. There was no special commission on valves; the commission was on sales, which covered everything.

Int. 171. What rate of commission did he get on sales?

Ans. I couldn't state the rate. I found this sum on the books, and so state it as I found it.

Int. 172. I notice you have not answered the inquiry as to
203 what salaried persons were stockholders, and also the inquiry as to the duties and services rendered by the salaried persons. Please answer.

Ans. George H. Crosby, superintendent; during the early part of this accounting he was in general charge of the business.

J. H. Millett, president.

George H. Eager, treasurer.

The above are all the salaried persons who were stockholders during the whole period.

Walter P. Clark, secretary, has been a stockholder for past two or three years.

J. B. Frost, traveling salesman.

F. T. Simmons, traveling salesman.

Fred. Vinal, shipping clerk and office boy.

George Kendall, office boy at first and subsequently book-keeper.

George Grant, boy in office.

William Hadley, shipper and clerk.

Edward Gilman, office boy or errand boy.

Jerry Conley, errand boy and assistant to Hadley.

Gilman W. Brown, salesman and machinist.

W. Dixie, clerk, salesman, and machinist.

H. A. Chamberlin, book-keeper.
Harry Ayer, traveling salesman.
George E. Boyden, traveling salesman.
William Crotty, office boy.
Michael Geary, office boy or errand boy.
S. C. Meady, foreman.
George H. Moore, salesman.
O. C. Wells, salesman.
I think that covers all as to their duties.

Int. 173. I have just been informed that some valves with the screw-ring sent out by you on consignment to the Keystone Iron Works and not by them paid for before the close of this accounting have recently been sold by your consignee. Do those valves appear in the account and schedules which you have rendered?

204 Ans. I couldn't say; I don't know anything about them.

Int. 174. Are all the valves exported to foreign countries or sold to foreign countries or to go to foreign countries included in the account and in the schedules of sales?

Ans. I am not aware that any valves were ever sent to any foreign country except England, and the valves sent to England are not included. Canada valves are.

Int. 175. Why were not the valves sent to England included? Were they not made in the United States?

Ans. The reason they were not included is that I did not suppose they would be required, because they were shipped to ourselves in London, and none were sent until after the expiration of the 1886 patent.

Int. 176. Were they not made before the expiration of the 1886 patent, or some part of them?

Ans. No; to the best of my knowledge and belief.

Int. 177. Did they not have a screw-ring?

Ans. I presume they did.

Examination of George H. Crosby.

BOSTON, *July* 10, 1885.

Examination by Mr. CLARKE:

I am one of the directors and superintendent of the Crosby Steam Gage and Valve Company.

Int. 1. What do you know about the accounts now shown you and heretofore filed in cases 1184 and 1199, and what did you contribute in the way of material to the making up of these accounts?

Ans. I contributed the cost prices; that is all.

Int. 2. How did you fix the cost of valves in 1879?

Ans. From my knowledge of the cost of material and the labor necessary to produce the valves fit for use.

Int. 3. When did you fix the prices named in these accounts as the costs of the valves for the period named in the account?

Ans. Since January of this year.

205 Int. 4. Did you, in any of the years covered by these accounts, fix, for the purposes of the company, the costs of valves for that year?

Ans. I have not, as covering the time of this accounting.

Int. 5. Did you, at any time from Feb. 15, 1879, till Jan. 31, 1885, fix, for the purposes of the company, the cost to the company of any description of valves mentioned in this account at any time which is included in the account?

Ans. I have stated, I think, from time to time, in answer to questions on the subject, but never in tabulated form, any such costs.

Int. 6. Have your statements about costs during this period, or any of them, been put in writing, so far as you know?

Ans. Not that I recollect of now.

Int. 7. Do you keep in your shop any books or memoranda relative to the costs of production or to the matters which go into the production of valves?

Ans. No books; but I have memoranda of the material and costs, but not of labor.

Int. 8. Did you, during any part of this period, do the labor on valves by piece work?

Ans. No.

Int. 9. It was all done by day labor?

Ans. Yes.

Int. 10. Did you make or buy ready made or have made for you any part of any of the valves carried in this account?

Ans. Yes.

Int. 11. What part?

Ans. The spring.

Int. 12. Were your springs generally made for you, or only occasionally?

Ans. Large quantities were; we made part of them ourselves, though.

Int. 13. What proportion of the springs did you make yourselves?

Ans. Springs for the 1-inch, 1¼-inch, 1½-inch valves, and springs for very light and very heavy pressures.

Int. 14. What proportion do the valves you have just mentioned, and for which you made springs, bear to all the valves in number?

206 Ans. I couldn't state precisely, unless the statement which shows the 1½ and 1¼ and 1 inch valves does. Quite a number of extra high and extra low pressures. There is no record of any way.

Int. 15. Are they not included in the valves here accounted for?

Ans. They are, but not specified, that I know of.

Int. 16. Did you do your own brass-founding for your valves?

Ans. We did.

Int. 17. Did you do your own iron-founding for valves?

Ans. No.

Int. 18. Was there any wrought-iron work on any of these valves?

Ans. Yes.

Int. 19. What?

Ans. Levers and bolts for stationary marine valves.

Int. 20. Did you make these levers and bolts for yourselves, or buy them already made?

Ans. We bought the bolts and nuts and made our own levers when made of wrought iron.

Int. 21. Was there any labor in finishing or fitting the brass valves which you had done by contract or otherwise than in your shop by day labor?

Ans. No.

Int. 22. Was there any work on iron valves done by contract or otherwise than in your shop by day labor, except bolts, nuts, springs, and iron foundings?

Ans. No.

Int. 23. Were the valves which you have called brass valves all made of the same material?

Ans. Yes; composition, excepting the spring.

Int. 24. Did you make the composition yourselves out of commercial metals, or did you buy the metal composition already formed?

Ans. We made it ourselves from metals; mixed them ourselves.

Int. 25. And what mixture of metal did you employ?

Ans. Eight copper to one tin, with a modicum of zinc and lead to cause them to mix and turn readily.

Int. 26. How large was the modicum?

207 Ans. In the neighborhood of one per cent.; it varies a little.

Int. 27. Now you have fixed the cost price of 1-inch safety-valves between Feb. 15, 1879, and May 1, 1880, at $2.50. Please tell me how you get that cost.

Ans. From my knowledge of the cost of the materials at the time and the cost of making at the time.

Int. 28. How much material did a 1-inch valve take at that time?

Ans. Two pounds of composition and a spring.

Int. 29. What was the cost of the spring at that time?

Ans. Twelve cents.

Int. 30. What was the cost of copper at that period?

Ans. The average cost of copper was 18⅝ cents per pound.

Int. 31. What was the average cost of tin?

Ans. Eighteen and one-third cents per pound for same period.

Int. 32. Did you purchase the metals during this period covered by the accounting?

Ans. Only occasionally; the treasurer did it ordinarily.

Int. 33. Where do you get these prices from?

Ans. From the treasurer.

Int. 34. Do you know whether the prices of copper and tin varied much during this year and four months?

Ans. Yes; they did.

Int. 35. How much?

Ans. Lowest of copper was 16 cents, and highest 22¾ cents; lowest of tin was 14⅜ cents, and highest 24 cents.

Int. 36. Were these high prices of copper and tin during the last part of the period or during the early part?

Ans. The last half.

Int. 37. What was the cost of moulding these valves during this period?

Ans. Seven cents a pound.

Int. 38. Do you include in that both the labor and the melting and running of the metal?

Ans. Yes.

Int. 39. Did you do this work, paying for it by the pound?

Ans. No.

208 Int. 40. Then this estimate of seven cents a pound includes fuel, does it?

Ans. Yes.

Int. 41. How do you make up the details of this price of seven cents a pound in terms of labor, fuel, and the other things that go to make up the amount?

Ans. By carefully computing them from time to time during the process of manufacture.

Int. 42. Now give me the figures of your computation for this period from Feb. 15, 1879, to May 1, 1880, which result in seven cents a pound for brass foundings.

Ans. I haven't them. I will furnish them. I should have to go over the facts again. This computation has been made over and over again with the same result. It is an average thing. I speak from memory.

Int. 43. An average thing for all composition castings during the whole period of the account?

Ans. Yes; on safety-valves.

Int. 44. And this price, added to the cost of material, makes the cost of the brass castings which enter into the valves, does it?

Ans. It does.

Int. 45. Now, have you any experience as to whether this cost of compositions castings charged in these accounts is a greater or less cost for the same period than the castings could have been obtained for by contracts of similar quality?

(Objected to as an inquiry as to what these materials may have cost outside parties, when the question is what did it cost defendants as produced by themselves. Excluded.)

Int. 46. Did you include in the estimate of moulding any allowance for the use of sand, and if so, what?

Ans. I did; I can't say what yet.

Int. 47. Did you include in the estimate of moulding any allowance for the use of moulding tools, or did the men furnish their own tools?

Ans. The men furnished their own small tools, and I think I did include for the flasks and other tools.

209 Int. 48. Now, wasn't this the way that you made up the cost of moulding, etc., to the company by the pound—by keeping the run for a period of time of all the foundry supplies and their cost and of the labor in the foundry, and also of the weight of finished castings produced during the same period, and dividing the aggregate cost of labor and supplies other than metal

by the number of pounds of finished castings produced, and taking the quotient as the cost per pound of brass founding?

Ans. I think not. I can answer that question more positively later, after I ascertain how I did make it up.

Int. 49. But the price of seven cents is substantially the price that you have charged for producing the castings during the whole period from Feb. 15, 1879, to Jan. 31, 1885, as I understand it?

Ans. Yes; it is.

Int. 50. Now, how did you make up the cost of finishing the castings which you have given in this account?

Ans. From my knowledge of the labor taken from time to time and general knowledge of the work.

Int. 51. How much labor was there to finish a 1-inch valve in the years 1879 and 1880?

Ans. We didn't sell any during that time.

Int. 52. Why is there one reported as made and sold during that time?

Ans. It was probably a 1¼-inch valve reduced with an inch connection and sold as a 1-inch valve.

Int. 53. How much labor was there in finishing a 1¼-inch valve in 1879 and 1880? Give me the time in hours.

Ans. About five hours.

Int. 54. And what price did you pay in 1879 and 1880 for the workmen who worked on valves?

Ans. The price paid will average, for the whole term covered, over $2.50 a day—over 25 cents an hour.

Int. 55. Now, did you charge anything for the use of lathes, tools, and machinery?

Ans. No.

Int. 56. What did you pay for putting the valves together?

210 Ans. That I couldn't inform you at the present time. I can hereafter, if you wish it.

Int. 57. What did it cost you to test valves and adjust them?

Ans. I make the same answer as to last. I will give you this and other details, if you require it, later.

Int. 58. I wish to know concerning each and every size of valve for each and every period named in the accounting the following items, which are involved in the costs you have reported:

(1.) The weight of castings, whether of iron or brass.

(2.) The price at which these castings are charged on the account.

(3.) The weight of iron forgings and the price at which such forgings are charged.

(4.) The amount of labor in hours, both on the iron and on the brass, in finishing each particular kind of valve.

(5.) The amount of labor in hours and the price of that kind of labor in putting the valves together, for each size and kind of valve.

(6.) The amount of labor in hours and the price paid for the labor in adjusting each size and kind of valve.

(7.) The amount of labor in hours and price paid for labor in cleaning each kind of valve after its testing and adjustment.

(8.) The amount of labor and the cost of material for packing the valves and cost of such labor.

I wish these statements in detail, and if you have any books or memoranda made during the periods reported in the accounting as to the costs at the time when the memoranda were made I wish them produced.

Ans. It will take some time to do this, but I will do it as you require.

(MEM.—This answer appears under Int. 89.)

Int. 59. I find in this account an item, "Costs of modification and reconstruction of stationary valves in 1882 and 1883, prior to Sept. 23, 1883." What does that item refer to and what are the elements that make it up?

Ans. I cannot give any account of this without looking up the items.

Int. 60. Did the prices of labor vary between February, 1879, and January, 1885?

211 Ans. Some.

Int. 61. Did your facilities for making valves enable you to make them with less labor in the latter part of this period than in the earlier part?

Ans. Some.

Int. 62. Have you, in making up this account, anywhere charged anything for the use of tools and machinery?

Ans. No.

Int. 63. Have you at any time since Feb. 15, 1879, till Jan. 31, 1885, reported to your company any price as the cost price of valves which included in the estimate of costs any other items than those which are included in the costs you have presented in this account?

Ans. Not that I have any recollection of.

Int. 64. Have you ever, in any discussion with the other members of the company for the purpose of determining the selling price of valves, given to them, at any time during the period of this accounting, as a cost price or as a price including all the costs of your department, any cost or price for any of the valves reported?

Ans. Not that I know of.

Int. 65. Did you not, in fixing the selling price of valves, take into consideration the cost of the valve?

Ans. Somewhat.

Int. 66. And who determined and reported this cost which was taken into consideration?

Ans. I determined it and reported to no one.

Int. 67. Did you alone, then, fix the prices at which valves were to be sold?

Ans. I made the list prices.

Int. 68. And who determined what discounts should be allowed upon the lists?

Ans. I did at first.

Int. 69. And who afterwards?

Ans. Those having control of the sales, rather.

Int. 70. Was not the person who controlled the sales limited in any way to a minimum price?

Ans. Not that I know of, as I had nothing to do with the sales afterwards.

212 Int. 71. During what period is the period you call "at first," in answer to Int. 68?

Ans. The first few years of our organization, which commenced in 1875.

Int. 72. What few years were those in annis Domini?

Ans. Part of 1875, 1876, 1877, and maybe a part of 1878. Afterwards there was a selling department with which I hadn't anything to do. I had all to do with regard to manufacturing after that.

Int. 73. Who had charge of the selling department in 1879, 1880, 1881, 1882, 1883, 1884, and January, 1885?

Ans. Mr. Clark took charge of it after it went out of my general supervision. Just what year he commenced I couldn't say positively.

Int. 74. And you wish to be distinctly understood, do you, that at no time after Mr. Clark took charge of the selling department did he ever seek from you or you ever give to him any statement or estimate of the cost or any part of the cost of safety-valves to the company, so far as you now recollect?

Ans. He has at times asked for the costs of parts or wholes, and I may have given him from time to time such information as I chose to.

Int. 75. Did you ever give him any information in response to any such inquiry?

Ans. I think probably I have, but as to its accuracy I wouldn't vouch for it. I have been very particular to keep such information to myself wholly.

Int. 76. Can you give me any estimate of cost of any sized safety-valve, which estimate you made between Feb. 15, 1879, and May 1, 1880?

Ans. No.

Int. 77. You don't know, then, what estimates of costs of valves you made during that period, do you?

Ans. Yes.

Int. 78. Then why did you say that you couldn't give it to me?

Ans. I can't give the estimates—the details, I understand by that—but I remember and know the cost at that time.

213 Int. 79. Give me, then, the cost of the valves as you called it in the years 1879 and 1880, for the period ending May 1.

Ans. It is shown by Schedule II of the account filed in No. 1199.

Int. 80. Please examine the other schedules in No. 1199 of the costs of valves and say whether those costs agree with the costs made up by you in the years to which they correspond.

Ans. They correspond.

Int. 81. These estimates of costs, therefore, are the estimates, and

the same estimates, which you made for the corresponding years of work in the corresponding years of work, are they?

Ans. They are what I know to be the results of estimates made at those times.

Int. 82. Have you the memoranda of the results reached at those times and made at those times?

Ans. No.

Int. 83. Did you ever have any memorandum of results of calculations of costs for any fiscal year of the Crosby Company made at the time of the calculation or about that time?

Ans. No; I have made memoranda at various times during each year on slips of paper for the purpose of ascertaining the cost of labor for my own information, which have been afterwards thrown into the waste basket after I got the information.

Int. 84. And these estimates of costs which you made from time to time, as I understand you, you did not communicate to the company or any of its officers, but kept them as private information. Is this so?

Ans. That is so. I might have given approximate information.

Int. 85. In making any of these estimates of costs from time to time did you ever add in any charges for general expenses, salaries, expenses of selling, and other outgoes of the company for non-producers, so that when the prices realized from sales were examined by you you could, for your own information or that of anybody else, determine whether the company was getting in its valve business a new dollar for an old one?

Ans. I never knew what those general expenses amounted to. I never calculated on anything but labor and material. That is all I had to do with.

214 Int. 86. Did you give to the company or any officer of it at any time during any period named in these accounts what you have been pleased to call in answer to Int. 84 approximate information about costs?

Ans. I think I have in conversation at various times, but nothing very definite.

Int. 87. Now, will you tell me whether that proximate information about costs which you gave approximated the actual cost as you had calculated it from a region of enhancement or from a region of discount?

Ans. Well, I wasn't very particular about it, one way or the other; just as it happened to suit me.

Int. 88. Did it suit you more often to approximate at a higher stated cost than the ascertained cost or at a lower stated cost than the ascertained cost?

Ans. Somewhat promiscuously.

(Adjourned.)

WEDNESDAY, *July* 21, 1885.

Int. 89. Have you the schedule inquired for?

Ans. In reply to Int. 58 I present the following:

Replies to Question 58.

1st. *Portable & Loco. Valves.*

W'g't compo.	2 lbs. for
" "	$3\frac{1}{2}$ " " $1\frac{1}{4}$"
" "	$4\frac{1}{2}$ " " $1\frac{1}{2}$"
" "	$7\frac{5}{8}$ " " 2"
" "	$13\frac{1}{2}$ " " $2\frac{1}{4}$"
" "	$15\frac{5}{8}$ " " $2\frac{1}{2}$"
" "	$22\frac{1}{2}$ " " 3"
"	
"	
"	
"	

Stationary & Marine Valves.

Compo.	Iron.
"	"
"	"
$4\frac{1}{2}$ lbs.	28 lbs.
7 "	35 "
11 "	42 "
14 "	50 "
18 "	62 "
25 "	91 "
55 "	160 "

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2d. Feb'y, 1879, to May, 1880,	Compo.	.25$\frac{3}{4}$	Iron 4 cts.
" " 1881,	"	.26$\frac{18}{100}$	" 4 "
" " 1882,	"	.26	" $3\frac{1}{2}$ "
" " 1883,	"	.25	" $3\frac{1}{2}$ "
" " 1884,	"	.22$\frac{6}{10}$	" $3\frac{1}{2}$ "
" Feb'y, 1885,	"	.19$\frac{7}{10}$	" $3\frac{1}{2}$ "

3d. I can give no weights, but the following cost prices are included in the finishing for stationary and marine valves for nuts, bolts, and common levers:

2"	$2\frac{1}{2}$"	3"	$3\frac{1}{2}$"	4"	5"	6"
.25	.42	.65	.82	1.05	1.28	1.60

Brass.

Port. & Loco. Valves.

4th. Feb'y, 1879, to May, 1880	1881	1882	1883	1884	1885
Hours.	Hours.	Hours.	Hours.	Hours.	Hours.
1"	$4\frac{3}{5}$	$4\frac{1}{8}$	$3\frac{1}{3}$	3	3
$1\frac{1}{4}$" $4\frac{1}{2}$	$4\frac{1}{4}$	4	$3\frac{3}{4}$	$3\frac{1}{5}$	$3\frac{1}{8}$
$1\frac{1}{2}$" $6\frac{1}{3}$	$5\frac{2}{5}$	$4\frac{3}{5}$	$3\frac{3}{4}$	$3\frac{1}{2}$	$3\frac{1}{2}$
2" $8\frac{3}{4}$	$6\frac{1}{5}$	$5\frac{1}{2}$	$4\frac{1}{8}$	$3\frac{4}{5}$	$3\frac{4}{5}$
$2\frac{1}{4}$" $14\frac{3}{4}$	$12\frac{1}{4}$	$11\frac{1}{3}$	10	$10\frac{1}{4}$	$10\frac{1}{4}$
$2\frac{1}{2}$" $17\frac{2}{5}$	$15\frac{4}{5}$	$14\frac{3}{5}$	13	$12\frac{4}{5}$	$12\frac{3}{5}$
3" $22\frac{3}{4}$	$20\frac{1}{4}$	17	$18\frac{3}{5}$	18	18

Iron Stat'y & Marine Valves.

2" $16\frac{2}{5}$	$13\frac{1}{5}$	$12\frac{3}{5}$	$9\frac{7}{5}$	$7\frac{4}{5}$	$6\frac{1}{5}$
$2\frac{1}{2}$" $28\frac{1}{2}$	$24\frac{1}{4}$	$19\frac{1}{8}$	$16\frac{2}{5}$	$14\frac{3}{5}$	14
3" $37\frac{2}{5}$	$34\frac{1}{2}$	$32\frac{7}{8}$	30	$27\frac{1}{2}$	27
$3\frac{1}{2}$" $52\frac{2}{5}$	$48\frac{1}{8}$	$45\frac{1}{8}$	$38\frac{1}{2}$	$36\frac{3}{5}$	$34\frac{3}{5}$
4" $68\frac{4}{5}$	$62\frac{3}{4}$	$58\frac{4}{5}$	$52\frac{4}{5}$	$47\frac{1}{5}$	$41\frac{7}{8}$
5"	79	$77\frac{1}{5}$	$72\frac{2}{5}$	$60\frac{3}{5}$	$60\frac{1}{4}$
6"				$71\frac{2}{5}$	$71\frac{1}{5}$

216 *Assembling & Adjusting Brass Valves.*

5th and 6th. From Feb'y, 1879,

to May, 1880		1881	1882	1883	1884	1885
	Minutes.					
1″		20	18	16	15	15
1¼″	22	20	18	16	15	15
1½″	30	26	24	22	20	20
2″	45	38	36	34	30	30
2½″	64	54	50	46	44	44
2½″	90	78	70	66	60	60
3″	112	96	88	82	75	75

One man does this.

Testing & Adjusting Brass Valves.

From Feb'y, 1879,

to May, 1880		1881	1882	1883	1884	1885
1″		26	24	22	20	20
1¼″	28	26	24	22	20	20
1½″	40	34	32	30	26	26
2″	60	50	48	46	40	40
2½″	86	72	66	64	60	60
2½″	120	104	94	88	80	80
3″	150	128	116	110	100	100

Two men are required to do this work, as one has to manipulate the fire and water in boiler.

7th. The amount of labor in cleaning or polishing brass valves is included in the amounts given for finishing; price paid for labor on valves is 25 cents per hour on all kinds of work.

Referring to the costs spoken of in Int. 27 and following, the answers refer to 1¼-inch valves rather than 1-inch valves, except Ans. 29, where the price given is of 1-inch valves of 1881, and not of 1879 and 1880, when there were no inch valves made.

Int. 90. I understand that the valves which appear in some of the later years of the account as ¾-inch valves are 1-inch valves with ¾ connection?

Ans. Yes; that is so.

217 Int. 91. What became of the brass waste from the brass-finishing shop?

Ans. It was put through a magnetic machine and recast.

Int. 92. Was any account kept of it?

Ans. No.

Int. 93. Can you tell what it amounted to?

Ans. Not exactly. I have used it as an offset against the time used in grinding tools, time lost on bad castings, time lost in water-closets, time used in carrying castings around, time used in mending belts, oiling up, etc. When I have not used it as an offset in this way it has been usual for me to add 10% to the cost and allow for the waste.

Int. 94. Do these weights which you have given represent finished or unfinished weights?

Ans. Unfinished weights.

Int. 95. Have you found me the costs of modification and reconstruction of stationary valves in 1882 and 1883?

Ans. I have found the only items which I contributed to that account and produce them, and they are as follows:

Of the costs of modification referred to in Int. 59, I submit the following:

1882, 1883, 25	4″	stationary valves	$600 00
32	3½	" "	576 00
27	3	" "	378 00
10	2½	" "	87 50
			$1,641 50

Allowance.

Springs	$50 00	
"	48 00	
"	27 00	
"	6 00	
Composition	61 25	
"	60 80	
"	40 50	
"	9 50	
		303 05
		$1,338 45

218	1881–'82, 7	2½ stationary valves	$66 50
	1882–'83, 6	2½ " "	52 50
			$119 00

Allowance.

Springs, $4.20; composition, $7.07	$11 27	
" 3.60; " 5.71	9 31	
		20 58
		$98 42

1881–'2, 2	2½	loco.	$18 00
1	2½	"	7 53
7	2	"	29 75
2	1½	"	5 80
			$61 08

Allowance.

Springs, $1.20;	compo., $4.50		$5 70	
" .50;	" 1.94		2 44	
" 2.80;	" 7.70		10 50	
" .50;	" 1.79		1 79	
				20 43
				$40 65
Totals, etc.				$1,338 45
				98 42
				40 65
Amounting to				$1,477 52

As to the cost of moulding castings inquired about, I obtained by taking the sum of the costs of labor and supplies for a specified time, and dividing that sum by the production of the foundry in pounds during such time. Of course, the comparative size and weight of the castings and the amount of cored work had afterwards to be taken into consideration. Rent, gas, and water were not taken into the account. The cost was ascertained at various times with the same average results.

Int. 96. Where did you get the items of cost and modification, etc., from that you have just given?

219 Ans. They were estimated from the known weights and labor of the various sizes and kinds of valves.

Int. 97. Who made the estimate, and what are the details of the estimate?

Ans. I made the estimate, and the details appear connected with it. The cost of the valves is shown in the corresponding years of the account, namely:

1882–'83, cost of 4-inch stationary valves, as shown in defendants' account, is $24; 3½, same year, $18; 3, $14; 2½, $8.75.

1881–'2, 2½ stationary, $9.50; 2½ brass, $9.00; 2¼ brass, $7.53; 2 brass, $4.25; 1½ brass, $2.90.

The number and size of the valves were furnished me from the office.

Int. 98. From this account of the cost of modification, it appears, does it not, that the cost of modifying was the cost of a new valve, less the price of the spring and composition employed in them?

Ans. The items in this account, given by me, were for valves destroyed. The allowance made was for the material we could use over again in some way or other.

Int. 99. Why are these valves destroyed—by accident or purposely?

Ans. Because we were making modifications of valves at the time to improve them.

Int. 100. Wasn't there any salvage on bolts and nuts?

Ans. Bolts and nuts are so small an item I didn't take it into account, even if they could be used over again.

Int. 101. Where were the Meady levers made that you used—in your shop or outside?

Ans. Made in our shop—the work was done. The malleable-iron castings were furnished by outside parties.

Int. 102. Is any estimate or allowance for levers made on the valves which use the Meady levers, or did you have both kinds of levers on one valve?

Ans. I don't know that there were any Meady levers on those stationary valves destroyed, and no allowance was made for anything except what we could use again.

220 I submit the following:

Cost of the Meady Lever.

Size.	Style.	Iron.	Labor.	Screw.	Patent.	Total.
2″	Marine,	.11	.13	.05	.10	.39
2″	Stat'y,	.09	.13	.05	.10	.37
2½″	M	.11	.13	.06	.10	.40
2½″	S	.11	.13	.06	.10	.40
3″	M	.19	.19	.07	.15	.60
3″	S	.19	.19	.07	.15	.60
3½″	M	.38	.25	.10	.24	.97
3½″	S	.26	.25	.10	.24	.85
4″	M	.68	.38	.13	.40	1 59
4″	S	.38	.38	.13	.40	1.29
5″	M	1.16	.50	.50	.72	2.88
5″	S	.60	.50	.50	.72	2.32
6″	S	1.00	.75	1.00	.92	3.67

Reply to Section 8, Int. 58.

Brass.	Box.	Labor.	Total.	Iron.	Box.	Labor.	Total.	
1″	4 cts.	1 ct.	5 cts.					
1¼″	6 "	2 cts.	8 "					
1½″	8 "	2 "	10 "					
2″	12 "	3 "	15 "		.14	6	.20	
2¼″	15 "	5 "	20 "					
2½″	15 "	5 "	20 "		.18	7	.25	
3″	18 "	7 "	25 "		.20	.10	.30	.20
3″						.10	.10	
3½″						.10	.10	
4″						.10	.10	
5″						.10	.10	
6″						.10	.10	

221 *Evidence for Complainants.*

Testimony of Charles A. Moore.

Direct examination by THOMAS W. CLARKE, Esq., of counsel for complainants:

BOSTON, *Dec.* 29, 1885.

Int. 1. Have you been manager of the business of the Consolidated Safety Valve Company, so far as putting the valves on the market is concerned?

Ans. Yes.

Int. 2. Have you examined the list of customers of the Crosby Steam Gage and Valve Company for safety-valves? And, if so, please state how far the list of customers of the Crosby Company corresponds with customers of the Consolidated Safety Valve Company or with persons with whom the Consolidated Safety Valve Company was in negotiation for the sale of their goods during the period of this accounting.

(Objected to as inadmissible, because it is directed to the ascertainment of damages to be charged against the defendants in addition to profits which the complainants seek to recover, and thereby to the consideration of such damages by the master, which is not within his authority as derived from a court of equity, and any allowance of which, if enforced, would be an invasion of the rights of the defendants as secured to them by the Constitution and laws of the United States. Exception.)

Ans. I haven't made any careful comparison of each individual account, but I should say that full 75 % of the names contained in the Crosby account and 85 % of the amount of goods sold were the customers that the Consolidated Safety Valve Company were in negotiation with and had at one time or another as their customers.

Int. 3. Taking the alphabetical list of the Crosby Company customers as compiled from their journal sheets in the hands of the master, please read the names of the Crosby Company custo-
222 mers which were either customers of or in negotiation with the Consolidated Safety Valve Company from Feb. 15, 1879, to Sept. 25, 1883, for the purchase of valves.

(Same objection. Exception.)

Ans. Alleghany Valley railroad, C. Aultman & Co., etc. I will furnish a list.

(Dec. 31, 1885.—List furnished, marked "Moore List (Int. 3), J. G. S., master.)

Int. 4. Please do the same thing with regard to the customers of the Crosby Company from Sept. 25, 1883, to Jan. 31, 1885.

(Same objection. Exception.)

Ans. I will furnish such list.

(Mem., Jan. 1, 1886.—Witness furnishes the list referred to above, and the same is marked "Moore List (Int. 4), J. G. S., master.")

Int. 5. With regard to the prices returned by the Crosby Company for their goods, how do those prices compare with the prices asked and obtained by the Consolidated Safety Valve Company for their valves of the same size as those returned by the Crosby Company as sold at or about the same period of time?

(Same objection; and, further, that, if deemed admissible, the question in its present form is not confined to the limits of the decree as they are determined by the prayer of the complainants' bill; on the contrary, if intended to seek damages, the breadth and comprehensiveness of the inquiry leads to the consideration of an amount which is indefinite and may extend beyond the authority of the master. Exception.)

Ans. I can answer that in detail, taking various customers and giving the exact amount or giving a range of percentages of differences that will cover the main differences in prices between that asked and obtained by the Crosby Company and asked and obtained of the same customers of the Consolidated Safety Valve Company.

Int. 6. Answer it generally and then give your particular instances.

(Same objection. Exception.)

Ans. Generally, the Crosby Company were from 10% to 50% below the prices of the Consolidated Safety Valve Company.

223 In no single instance do I find that these prices were as much as those of the Consolidated Safety Valve Company. In particular instances I will take first C. Aultman & Co.

In 1879 I named a price on a valve for their farm-engine use of $7.00 net for each valve. The Crosby Company, I was informed, bid very much lower, and they were awarded the order, and I have learned since from this account that their price at that time was $5.00 for the same sized valve and finally ran down to $3.75.

In the case of Atwood & McCaffrey, in 1879 and 1880 I quoted them on 1¼-inch valve, $7.00; on 3-inch valve, $45, and have learned since from this account that the Crosby Company quoted them for 1¼-inch valve, $5; for 3-inch valve, $28.

In case of the Ames Iron Works (1879), I quoted them a discount of 50 % from our list for farm-engine valves, and Crosby quoted them for ¾-inch valve, $3.50 net; 1-inch valve, $4.00 net; 1¼-inch valve, $5.00 net.

E. M. Birdsall & Co.: I quoted them $5.25 for 1-inch valve; $4.75 for ¾-inch valve; $7.00 for 1¼-inch valve.

Birdsall informed me that he gave the order to the Crosby Company because of their low price, and I found by examination of the account that in 1880 Crosby sold them 1¼ valve at $5.00.

In case of Richard Dobbins, I quoted Mr. Dobbins on 2-inch valve, $26; 3-inch valve, $50; 3½-inch valve, $58.

Crosby sold him, I find by this account, 2-inch valve at $10.50; 3-inch valve at $22.75; 3½-inch valve at $28.

W. H. Dillingham & Co.: We were selling 3-inch valves at $45 net, and I find by this account that Crosby sold them a 3-inch valve at $19.50.

A. B. Farquhar: I quoted him a 1-inch valve at $5.00; 1½-inch valve at $10.50.

I find from this account that Crosby Company sold him 1-inch valve at $2.35; 1½-inch valve at $6.00.

Fitchburg Steam Engine Company: In 1879 I quoted them 1½-inch valve at $12.50; 2-inch valve at $15. Crosby sold them 1½-inch valve at $7.00 and a 2-inch valve at $10.50.

When I speak of valves I name only one, but often there are large quantities of valves sold, running into several hundreds.

224 Harrisburg Car Manufacturing Company: In 1879 I quoted them for 1-inch valve, $5.00; 1½-inch valve, $7.50.

I find from this account that the Crosby Company sold them a 1-inch valve at $3.25 and 1½-inch valve at $4.50.

The Hinckly Locomotive Works: I quoted them the locomotive valve at $20 net. Crosby sold them, I find by this account, at $13.50.

Lane & Bodley: I quoted 2-inch valve at $24; 2½-inch valve at $33; 3-inch valve at $45. I find that Crosby sold 2-inch valve at $10.50; 2½-inch valve at $17.50; 3-inch valve at $22.75.

Mansfield Machine Works: I quoted the 1-inch valves, $5.75; and I find that Crosby sold them 1-inch valves at $2.75.

Charles Perrigo & Co.: I quoted them 1-inch valve at $5.00. Crosby sold them 1-inch valve at $4.00.

Pitts Agricultural Works: I quoted them 1-inch valve at $5.00 net. I find that Crosby sold them 1½-inch valve at $3.75.

E. W. Payne & Sons: I quoted them on 1-inch valve, $5.00 net; 1½-inch valve, $7.50. I find from this account Crosby sold them 1-inch valve at $3.50; 1½-inch valve at $5.00, and later than 1880 reduced 1½-inch valve to $3.50.

H. K. Porter & Co.: I quoted and sold 1½-inch valve at $13.50; 2-inch valve at $15. Crosby, I find, sold 1½-inch valve at $8.00; 2-inch valve at $10, and later reduced 1½-inch valve to $7.50; 2-inch valve to $9.50.

Porter Mfg. Co.: In 1880 I quoted 1-inch valve at $5.00; 1½-inch valve at $7.50; 1½-inch valve at $10; 2-inch valve at $15; 2½-inch valve at $20. I find by this account that Crosby Company sold 1-inch valve at $3.00; 1½-inch valve at $3.50; 1½-inch valve at $4.50; 2-inch valve at $9.00; 2½-inch valve at $15.

Russell & Co.: I quoted them 1½-inch valve at $7.50; 1½-inch valve at $10; 2-inch valve at $15. I find that the Crosby Company sold them 1½-inch valve at $3.75; 1½-inch value at $6.00; 2-inch valve at $8.00.

Silsby Mfg. Co.: I quoted and sold the 1½-inch valve at $12. I find Crosby sold 1½-inch valve at $8.00.

Schenectady Locomotive Works: I quoted encased locomotive valve at $20. I find the Crosby sold same at $15.

225 Union Pacific Railroad Co.: I quoted 2½-inch locomotive valve at $30. I find Crosby sold at $22.50.

These are samples.

In the case of Babcock & Wilcox, I quoted them as follows: 2-inch valve at $20; 2½-inch valve at $27.50; 3-inch valve at $37.50; 3½-inch valve at $43.50; 4-inch valve at $50. I find by the account that the Crosby Company sold them 2-inch valve at $12; 2½-inch valve at $15; 3-inch valve at $22.75; 3½-inch valve at $24; 4-inch valve at $28.

This is a large account, a large customer.

Int. 7. From the information which you received as to the inferior prices at which the goods of the Crosby Company, defendants, were offered in competition with goods of the Consolidated Safety Valve Company and the ascertainment that you had not obtained the trade for which you were in competition, did you, in the year 1879 or later, make any, and what, changes in prices asked for the Consolidated Safety Valve Company's goods and in the prices at which they were sold; and, if so, what changes and in what direction?

(Same objection as heretofore made; and, further, if deemed admissible, that the inquiry is based upon hearsay information, if the information mentioned in the question is that which the witness has testified of. Question excluded.)

Int. 8. Did you or not have any information from time to time purporting to give prices at which the Crosby Company, defendants in this proceeding, were offering goods of their manufacture in competition with the Consolidated Company's goods; and, if so, did that information lead you to believe that their prices for similar sized valves in competition with the Consolidated Safety Company's valves were higher or lower than those quoted and asked for the Consolidated Safety Company's valves, and has that belief been confirmed or dissipated by an examination of the prices returned by the Crosby Company as the selling prices of their goods; and if you did anything with regard to the prices of the Consolidated Safety Valve Company's goods in consequence of the belief which you thus formed, what did you do?

226 (Same objections as above; and, further, that the inquiry seeks to determine the judgment of the witness based upon hearsay testimony, and upon such mere personal opinion seeks to charge the defendants. Objection overruled and exception.)

Ans. I have had information given me both orally and in writing, memoranda of the oral answers I made in memorandum books and find corroborated by the prices given here, and by repeated assurances from customers that the Crosby Company were awarded their contracts or orders because the Crosby Company's prices were very much lower than the prices I made them for the Consolidated Company's goods, and because of the evidence given me, as before referred to, I was compelled to materially reduce our prices in order to secure trade and retain our customers.

Our reduction in prices to many customers was a difference varying from 10% to 25% and even more.

Int. 9. What was the volume of business of the Consolidated Safety Valve Company during the several periods covered by this accounting?

(Objected to as appears to Int. 2 and Int. 5 and exception.)

Ans. I cannot give the exact figures, but the sales amounted to something over $300,000 between February, 1879, and January, 1885:

Sales from	February,	1879, to	May 1,	1880	$23,544 04
	May 1,	1880, "	"	1881	33,220 76
	"	1881, "	"	1882	56,648 93
	"	1882, "	"	1883	88,930 05
	"	1883, "	"	1884	71,929 09
	"	1884, "	"	1885	57,653 06
					$331,925 93
And I estimated that the sales from Jan. 31, 1885, to May 1, 1885, were about					$15,000 00

Int. 10. In making sales prior to Sept. 25, 1883, was the adjustable feature of the safety-valve which involved the use of a screw-ring insisted upon as matter of importance either by the Consolidated Safety Valve Company or by the Crosby Steam Gage and Valve Company?

227 (Objected to as to the latter part of the inquiry, as all information which the witness may have is wholly hearsay, and as to the former part there is no evidence of value in anything the complainants may insist on, and, if the question is intended to lay the foundation for damages, the same objections that are offered to Ints. 3 and 5 are offered to this interrogatory. Exception. Witness is instructed by the master that he is not to state matters of hearsay in answer to this question.)

Ans. The Consolidated Safety Valve Company did lay great stress upon the adjustable feature of their safety-valves by means of a screw-ring, and with the users of safety-valves that feature was considered so valuable that we were required to furnish the adjustable screw-ring with all safety-valves, and from my experience in the manufacture and sale of safety-valves, I am confident that it would have been almost impossible to have sold our safety-valves without the adjustable screw-ring to a majority of users of spring-loaded safety-valves. In regard to the prominence given to the adjustable screw-ring by the Crosby Steam Gage and Valve Company, I have in my possession catalogues issued by them and advertisements placed in the mechanical journals of the country, and in each and all of them the adjustable feature is set forth in very prominent type and universally referred to.

Int. 11. Please produce any such catalogues and advertisements

purporting to be the catalogues and advertisements of the Crosby Company, which you have referred to in your last answer.

Ans. I will.

Int. 12. In your judgment, after the prominence that had been given to the adjustable feature of safety-valves, prior to Sept. 25, 1883, would it have been possible to have sold safety-valves not having the adjustable feature at the same price after Sept. 25, 1883, that safety-valves with the adjustable feature were sold at?

(Objected to as seeking to get the witness's opinion rather than the facts of what was done in the trade. Exception.)

Ans. It would not have been possible, in my judgment, to have sold safety-valves without the adjustable feature at as good a price as safety-valves with the adjustable feature to customers who were familiar with the advantages that valves possessed having the adjustable feature over those not having it.

228 Int. 13. During this period from Sept. 25, 1883, to Jan. 31, 1885, were there, so far as you know, any Crosby Company's safety-valves on the market, which did not have the adjustable ring, by which might be regulated at will the difference between the opening and closing pressure on the valve?

Ans. I never saw any nor heard of any being offered for sale.

Int. 14. Since the injunction order in this case was made I am informed that the Crosby Company have been making valves without the adjustable ring. Have you seen such valves on the market?

Ans. I have seen very few in the hands of customers, but did not examine them closely to determine whether they had the screw-ring or not.

Int. 15. Has the competition of the Crosby valve with the Consolidated Safety Company's valve, since the injunction order in this case, been as close and serious as it was before?

(Objected to as immaterial, because it becomes a mere guess on the part of the witness as to what the Crosby Company's business is since the period named in the question, with which the witness undertakes to measure the complainants' transactions without giving the facts as to the transactions of both companies, and, further, that the question relates to things and the business in things which are not before the master in this accounting proceeding, as it isn't intimated that the defendants' business is in valves which infringe or claim to infringe the complainants' patents. Excluded.)

Int. 16. Since the injunction order in this case, have the Crosby prices for non-adjustable valves been quoted to you as frequently as reasons for your lowering the asking price of the Richardson adjustable valve or have they been as forcibly insisted on as prior to the decree the Crosby prices for adjustable valves were quoted and insisted upon?

(Objected to, so much of the inquiry as tends to lay the foundation for damages, the reasons being found in objections to Ints. 2 and 5. In general, the defendants object to the questien, because there is

no evidence that this witness is qualified to make an answer, and that any answer is immaterial. Excluded.)

Int. 17. Since the injunction order was entered in this case have the complaints as to the Consolidated Company's prices for
229 adjustable valves been as frequent or as persistently urged as they were before the Crosby competition in adjustable valves was eliminated by the injunction order.

(Objected to, as to whatever of the question tends to inquire about damages for the reason stated in objections 2 and 5. They also object to the inquiry because that, while complaints of the complainants' valve prices made to the complainants since the period named may have everything to do with the administration of the complainants' affairs and may be very material to them in the making of money, they can in no way determine the issue before the master under the decree.)

MASTER: This question bears upon the question of damages, not of profits. It is well settled that damages in cases like the present must be specifically proved, not inferred. I am of the opinion that the line of inquiry indicated by this question cannot properly be allowed by me, and counsel may understand that I exclude all questions calling for conversation or statements between the complainants and their customers since the injunction order, unless the defendants are properly connected therewith. This question is excluded.

Int. 18. Have you been in the habit during the period from and after Feb. 15, 1879, and before that date of travelling about the country in the business of the Consolidated Safety Valve Company and the introduction of their goods and of visiting purchasers and consumers of goods dealt in by the Consolidated Safety Valve Company, and do you know personally any and how many of the persons or firms or managing or purchasing agents of firms and corporations enumerated as customers in the accounts rendered by the Crosby Company?

(Objected to, as to so much of said inquiry as relates to damages and for reasons stated in the first, second, and third paragraphs of their discharge. Exception.)

Ans. I have devoted very considerable time of the period referred to in visiting different parts of the country, extending as far west as the Pacific coast, all the principal cities of the United States, and a large portion of the railroads, for the purpose of advancing the interests of the Consolidated Safety Valve Company, and I
230 am personally acquainted with one or more members of firms or some officer of corporations whose names appear in the accounts of the Crosby Company to the extent of about 75% of the names given in their account.

Int. 19. Before the organization of the Consolidated Safety Valve Company had you been engaged in the manufacture and sale of pop safety-valves?

Ans. I had.

Int. 20. And was the business of manufacturing and selling pop safety-valves in which you had formerly been engaged consolidated with the business under the Richardson patents on the formation of the Consolidated Safety Valve Company?

(Objected to, and for reasons refer to objection to Int. 18, and, further, that it is wholly immaterial to the issue before the master as to what business this witness was in and what became of that business, outside of the question in hearing. Exception.)

Ans. It was, the valve portion of the business.

Int. 21. For what sorts of engines had pop safety-valves been introduced, if you know, by the manufacturers under the Richardson patents and by the house with which you had been concerned prior to 1879, and what sort of customers were the principal customers at that time?

(Same objection, and the defendants call the attention of the master to the hearsay foundation given in the inquiry upon which the witness is to make his answer. Exception.)

Ans. The Richardson valve occupied almost the entire railroad field, as I found them upon the locomotives of every railroad that I visited in my business of introducing the safety-valves that I was selling, together with other goods used on locomotives. The valves I represented directly were sold to the portable farm-engine trade and to stationary and marine boilers, we being the first in the field to introduce our spring loaded valve to the attention of the farm-engine trade.

Int. 22. What sizes of valves are used on what are called farm engines?

Ans. Sizes ranging ¾, 1, 1¼, 1½, and 2 inch, the great bulk being 1 and 1¼ inch.

231 Int. 23. Are these engines made in considerable quantities? And, if so, please name the houses in the Crosby list of customers who have been manufacturers of farm engines during the period of this accounting.

Ans. C. Aultman & Co., Aultman & Taylor, Atlas Engine Works, Ames Iron Works, Batavia Portable Engine Co., E. M. Birdsall & Co., H. & F. Blandy, Ball & Naylor, J. I. Case & Co., Cooper M'f'g Co., P. K. Dedrich & Co., Erie City Iron Works, A. B. Farquhar, Frick & Co., Harrison Machine Works, Garr, Scott & Co., Griffith & Wedge, Gibbs & Sterrett M'f'g Co., Geiser M'f'g Co., Harrisburg Foundry and Machine Co., Huber M'f'g Co. Haggert M'f'g Co., Hagerstown Steam Engine Co., Houven, Owens & Reutchler Co., D. June & Co., Jarvis, Barnes & Co., Lane & Bodley Co., James Leffel & Co., Lansing Iron Works, Marshall, Graves & Co., Charles Perrigo & Co., B. W. Paine & Sons, Peck & Tracy, Porter M'f'g Co., Pitts Agricultural Works, Russell & Co., Reynolds & Lang, M. & J. Rumley, Robinson & Co., Stearns M'f'g Co., J. O. Spencer & Co., Scheidler & McNamara, Sinker, Davis & Co., Stevens, Turner & Burns, Skinner & Arnold, R. Scheidler & Co., George W. Tift, Sons

& Co., Talbot & Sons, Taylor M'f'g Co., Tanner & Delany Co., G. Westinghouse & Co., Wood & Co., Watertown Steam Engine Co., Wood, Taber & Morse, Waterous Engine Works Co., Brownell & Co., Eagle Machine Works, Mansfield Machine Works, Noble & Hall, Northwestern Car M'f'g Co., T. M. Nagle.

Int. 24. Of these farm-engine builders you have enumerated, which of them were your customers during the year 1885?

(Objected to same as to Int. 18 and exception.)

Ans. Pitts Agricultural Works, Westinghouse Company, Wood & Co., J. O. Spencer & Co., Northwestern Car Manufacturing Co., Peck & Tyler, Charles Perrigo & Co.

Int. 25. In the year 1885 had you made any considerable reduction in prices for farm-engine valves over the prices of the preceding year?

(Same objection, and, further, that any act on the part of the complainants since January, 1885, unless made to specifically
232 bear on the question at issue, is wholly immaterial if the question should be deemed admissible by the master, and exception.)

Ans. I did make a very considerable reduction.

Int. 26. At what time in the year usually are the contracts for farm-engine valves placed?

(Same objection and exception.)

Ans. During the months of November, December, and January, and some as early as October.

Int. 27. What of the farm-engine builders did you sell to under the contracts of the fall of 1884?

(Same objection and exception.)

Ans. Russell & Co., M. & J. Rumley, G. Westinghouse & Co., J. O. Spencer & Co., Northwestern Manufacturing Company, Charles Perrigo & Co., Pitts Agricultural Works, J. I. Case & Co.

Int. 28. Whether or not the manufacture and sale of farm engines during the year 1885 has been as extensive as in previous years that have fallen under your observation?

(Same objection and exception.)

Ans. It was very considerably less.

Int. 29. Do the houses which you represent deal in other appliances and fittings for steam-engines than safety-valves?

Ans. They do very largely in all the attachments to a steam-boiler.

Int. 30. Whether or not the market in the year 1885, for other steam-engine appliances, indicates any different condition of business of the steam-engine trade than the market for safety-valves indicates?

(Objected to as immaterial.)

Ans. It did not indicate any livelier trade for the other appliances than for safety-valves.

Int. 31. Have you ever, among the farm-engine dealers, been given any other reason for preferring the Crosby valve than its inferiority of price?

(Same objection as to Int. 18, and from the fact that it is wholly hearsay. Excluded. Complainants' counsel excepts.)

Int. 32. Which of the customers reported by the Crosby Company were customers during the period of this accounting of the Consolidated Safety Valve Company for their locomotive valves?

233 (Same objection as to Int. 18 and exception.)

Ans. I should have to consult our order books to make an answer to this question. I will do so and furnish a list.

Int. 33. What other spring-loaded pop safety-valves were in competition, and how extensively, with the Consolidated Safety Company's goods during the period of this accounting?

(Same objection as to Int. 18 and exception.)

Ans. For the farm-engine trade the only active competitor that we met was a valve known as the Kunkle valve; for the locomotive trade, the Ashton and Kunkle; for the stationary, the Ashton and the Orme valve. There were two or three minor valves, that were but little known in the market, that are hardly worthy of naming as competitors.

Int. 34. How did the prices of these valves you have referred to compare with the prices of the Crosby valves returned?

(Same objection as to Int. 18 and exception.)

Ans. They varied according to relative sizes and localities where they were sold, but the general average of the Crosby prices was lower than those of the other valves named.

(Defendants move here to strike out both question and answer as wholly inadmissible. Motion denied.)

Int. 35. Did you, in consequence of the competition of either of these other valves, make any, and, if so, what, reduction of your prices during the period covered by this accounting?

(Same objection and exception.)

Ans. I did make a reduction in a few instances, because of the competition of the Kunkle valve.

Int. 36. Was the extent of that reduction greater or less than the reductions you were making at the same time to other farm-engine manufacturers on account of the competition of the Crosby valve?

(Same objection and exception.)

Ans. It was very much less.

(Adjourned.)

234 DEC. 31, 1885.

Int. 37. Will you please produce to the master Crosby catalogues issued during the period of this accounting and referring to the adjustable feature of the pop safety-valve made by them, with such references marked?

(Same objection and exception.)

Ans. I produce four such, and I have another which I will produce, marked "Crosby Catalogue A (Moore, 37), J. G. S., master;" "Crosby Catalogue B (Moore, 37), J. G. S., master;" "Crosby Catalogue C (Moore, 37), J. G. S., master;" "Crosby Catalogue D (Moore, 37), J. G. S., master."

Int. 38. Are you familiar with the operation of pop safety-valves in use on boilers and their adjustment and management?

Ans. I am.

Int. 39. Suppose a pop safety-valve with a given spring be adjusted to open and blow off steam at any given pressure—for instance, one hundred pounds to the square inch—and close when the pressure to the square inch had been reduced a certain percentage, say 3 %. If it be desired to adjust that valve to lose the same percentage of steam, but to open with a higher or lower pressure, would it be possible to do this without changing the spring, but by simply screwing it down so as to hold more pressure to the square inch; and, if so, how would such percentage of reduction be maintained with the change of tension of spring?

(Objected to.)

Ans. If the screw-ring is on the head of the valve and the increased compression of the spring reduces the pressure on the boiler too much, turn the ring up to enlarge the stricture. If the screw-ring is on the valve seat, turn the ring down to enlarge the stricture.

Int. 40. Can this suggested manipulation of spring and stricture be practised while the valve is on the boiler and without letting down the steam or shutting it off from the valve?

(Same objection.)

Ans. It can.

Int. 41. Now, suppose that you have no means of adjusting the stricture, but wish to change the pressure at which the valve blows off without changing the percentage of loss, what do you have to do?

235 (Same objection.)

Ans. You have to remove the valve, and if the change of initial pressure was only a small amount you could probably place the valve in a lathe and with a burnishing tool burnish off or spread out the top of the valve enough to compensate for the change in the compression of the spring, but it would be a work of cut and try, and might involve any number of operations until you happened to get the required proportions, which would depend very much upon the skill of the workman and his familiarity with the construction of the valve. In case of the change of initial pressure

being any considerable amount and the valve a large one, the burnishing tool would not answer. You would have to substitute a turning tool and take off a chip, and running the risk of changing the conditions or form of the valve so radically that the valve would be less effective than it was before.

Int. 42. Now could you retain the size of stricture and the percentage of loss and make a difference in the opening and closing pressures; and, if so, how would that be done?

(Same objection.)

Ans. The only way I know of doing that would be as I stated in my former answer or by use of the adjustable screw-ring.

Int. 43. What effect would it have upon a pop safety-valve and its percentage of loss if you substituted for a spring compressed a quarter of an inch to hold one hundred pounds pressure to the square inch a spring compressed a quarter of an inch to hold one hundred and twenty-five pounds pressure to the square inch? What would be the respective blowing-off points of such a valve with the different springs, and what would be the percentage of loss with the two springs respectively in the given cases?

(Same objection.)

Ans. The effect on the point of closing caused by increasing the pressure with the adjustment unchanged would be make it lose more steam, or rather close at a greater percentage of reduction from the opening point than it would at the lesser pressure. The percentage of loss due to the increased compression to the spring would vary some, according to the difference in size of valves, which would be greater in a large valve than in a small one.

236 Int. 44. Let us call your attention to a specific illustration: Suppose a valve with a given stricture had a spring compressed one-fourth of an inch to hold one hundred pounds to the square inch and blew down to ninety-seven pounds to the square inch, and then closed; you take out the spring and substitute for it another spring, which, with the same compression, allows the valve to blow at a pressure of two hundred pounds to the square inch; at what pressure with that valve will the new spring close, in pounds?

(Same objection.)

Ans. I can't recall any experiment of that particular character, as it figures in my mind, well enough to give it here, but I should say the reduction would be about six pounds and the valve would close at one hundred and ninety-four pounds.

Int. 45. Now, if you were going to change the spring of a pop safety-valve in order to change the blowing-off pressure and keep the stricture permanent for any reason satisfactory to yourself, would it be possible to make the change of spring without either drawing down the pressure on the boiler or shutting off steam from the valve?

(Same objection.)

Ans. It would not be possible.

Int. 46. If steam were shut off from the valve during the time that such a change was being effected, would or would not the safety of the steam equipment be impaired during the period of effecting this change?

(Same objection.)

Ans. It would be very seriously impaired.

Int. 47. Have you encountered in the market since the injunction in this case any Crosby pop safety-valves without the adjustable feature; and, if so, have you noticed whether they are accompanied by directions for changing the blowing-off pressure of the valve?

(Same objection as appears to Int. 18 on the question of damages, and exception.)

Ans. I have seen Crosby valves in the hands of purchasers, furnished by the Crosby Company since the injunction order, and they were accompanied with instructions, printed on a card and
237 attached, to the user how to proceed in case he desired to make a change in the point of opening and closing.

Int. 48. Please state, at or about the time of the formation of the Consolidated Safety Valve Company and for six month- thereafter, what were the best prices allowed to customers of different sizes of valves, according to their size, for the spring safety-valves manufactured by that company.

(Same objection and exception.)

Ans. To railroads our price for two valves for a locomotive was $50 a pair. We made an exception to the Baltimore & Ohio for a large number—forty-five valves—of $45 a pair. This was a 2½-in. locomotive.

(Cut produced is marked "Moore Cut A, J. G. S., master.")

In the first part of the time spoken of in the question we made a brass-case valve of that kind (cut produced is marked "Moore Cut B, J. G. S., master"), which we termed our brass-top outlet valve, and quoted as our lowest discount 50% from the list as printed, but in a very few instances we quoted the 1-inch at a net price, $6.00; 1¼, $7.50; 1½, $11.50; 2, $15. We then made the valve I now offer cut of (cut produced is marked "Moore Cut C, J. G. S., master"), which cost us less money, and in that period we quoted of that style of valve, 1-inch, as low net as $5.00; 1¼, $7.00; 1½, $11, and made no quotation of ¾-inch at that time. On the iron-case valves (cut produced is marked "Moore Cut D, J. G. S., master") we quoted 1-inch, $10; 1¼, $14; 1½, $20; 2, $24; 2½, $30.25; 3, $45; 4, $70; 5, $100. Those were special quotations, but we quoted and sold a great many at discounts *arranging* from 15% to 25% from the list handed you; and the prices named you as net were extreme cases, to answer the question as I understand it, to give lowest quotations on that class of goods during the period mentioned.

(Defendants' counsel produces and submits three several notices, which he hands to complainants' counsel in answer to his request made after Int. 47, and desires that they shall be marked "A," "B," and "C.")

Int. 49. Is either of the three documents just produced, and, if so, which, the tag which you referred to this morning as on the new Crosby valve?

(Same objection and exception.)

Ans. Yes; the one marked "B" is.

238 Int. 50. Had you noticed on the Crosby valves seen by you before the injunction in this suit any tag or other notice containing the same or similar instructions?

(Same objection.)

Ans. I never did.

Int. 51. From the information you received from time to time in the course of your business of introducing and selling the goods of the Consolidated Safety Valve Company, did you form any belief as to the defendants' competition for the safety-valve business by reduction of the prices at which goods were sold in the market?

(Same objection, and, further, that it is wholly inadmissible because it seeks only for the belief of the witness founded on hearsay statements.)

MASTER: I suggest to the counsel for complainants that he limit his question by inserting after "any belief" the words "upon which you, as the president and general manager of the complainant company, acted in modifying the prices at which you offered and sold the complainants' safety-valves containing the patented improvement in question in this suit."

(Counsel for complainants declines to modify his question as suggested, and question excluded, and complainants except.)

Int. 52. Did you, in your capacity of president and general manager of the complainant corporation, have control of the fixing of prices at which safety-valves embodying the improvements described in the patents in suit were sold and offered for sale by complainant corporation?

(Same objection.)

Ans. I had the entire control of making prices for the sale of our valves.

Int. 53. Did you, after the prices were originally established in 1879, lower the prices asked for such valves to customers with whom you were in negotiation from time to time?

(Same objection and exception.)

Ans. I did.

Int. 54. What reason had you at any time for making such concession of price?

(Same objection, and, further, that the question is wholly
239 inadmissible if intended to seek damages, as the defendants cannot be bound by any reason which the witness may have to influence him in relation to reduction of prices. Excluded. Excepted to.)

Int. 55. Did you, as president and general manager of the complainant corporation, make changes in the prices of the safety-valves embodying the inventions of the two patents in suit in the latter part of the year 1879 and later, in consequence of a belief that the defendants were engaged in a competition with the Consolidated Safety Valve Company for the same customer and for the same trade, and in order to obtain the customers and trade were offering to the said customers and the said trade the goods manufactured by the defendants and embodying the inventions of the plaintiffs' patents at lower prices than the complainants were offering their goods at?

(Same objection, and, further, that the question is wholly inadmissible as attempting to charge the defendants in damages upon a mere belief of the witness, and there being no evidence that those prices which were supposed to be modified by the witness were the prices of valves actually offered to the parties and made in accordance with the patents of the complainants, which the court decided were infringed by the defendants.

Admitted *de bene*. The master will deal with this question and the answer which shall be given thereto previously to his draft or his final report or in said draft or said final report. Defendants' counsel states that if the answer now admitted *de bene* shall be used as proof in the determination of damages to be charged against the defendants he reserves the right to except.)

Ans. I did make a reduction of prices in order to secure the sale of our valves to our customers because of the lower prices for the same sized valves quoted to the customers by the Crosby Company.

Int. 56. From what information did you form the belief that the Crosby Steam Gage and Valve Company were quoting lower prices for the same sized valves?

(Objected to as inadmissible. Admitted. Saved.)

Ans. From being shown the letters written by the Crosby Company to my customers and seeing bills from the Crosby Company for pop safety-valves made by them and the loss of customers who stopped buying our valves and did purchase the Crosby
240 valves, and, in reply to my personal inquiry to them why they had made the change in the purchase of goods, they stated to me personally that the sole cause was the very much lower price at which the Crosby Company sold them valves than the price I was asking them for my valves.

(Defendants move the master and ask that their motion be heard at this time to strike from the record all of said answer.)

(Adjourned.)

JAN. 1, 1886.

MASTER: The complainants will be permitted to show any acts which the defendants have done tending to prove that the safety-valves manufactured by them containing the patented inventions of the complainants were in competition with the safety-valves of the complainants also containing the said patented improvements, and tending to prove the nature of that competition and the damages resulting therefrom to the complainants. If the complainants made any reductions in prices by reason of said competition or lost any trade thereby they will be permitted to show that. If the complainants made reductions in the prices of their valves during the period of the accounting, which they claim were made on account of defendants' competition as aforesaid, they will be permitted to prove, if they can, that the reductions were made on account of said competition. Indeed, a failure to do this would prevent any recovery of damages therefrom. Complainants are not, however, to introduce any hearsay evidence as to the acts of the defendants, and particularly they are not to prove any conversations between the complainants' president and general manager and their customers or to give evidence of the contents of letters which said president may have seen by the testimony of the president without laying the usual foundation for such evidence.

In accordance with the views above expressed, I strike out all of Ans. 56 except the words "from * * * the loss of customers who stopped buying our valves and did purchase the Crosby valves," and I admit Int. 55 and answer, striking out my *de bene* reservation.

(Ruling objected to by defendants, as stated in their objection to Int. 55, and exception saved.)

241 To that part of the ruling which holds that the part of the answer stricken out is hearsay, or is an attempt to state the contents of other documents, or is an attempt to show any act of the defendants not hitherto shown positively by the defendants' own accounts, complainants except.

Defendants urge the objection to Int. 56 already given and except to the ruling.

The witness produces a list of the names as requested in Int. 4.)

Int. 57. In 1879, when you established the prices for the goods of the Consolidated Safety Valve Company, had you regard to the state of the market for safety-valves as you knew it at that time from your experience in placing similar goods for the predecessors of the Consolidated Safety Valve Company in the same line of business; and, if so, were the prices which you then established higher or lower than the prices that had heretofore been readily obtained?

(Defendants object to so much of the question which seeks damages, and refer to paragraphs 1, 2, and 3 of their discharge for their reasons and objection. Admitted. Saved.)

Ans. I did arrange the prices according to my judgment, based upon my experience in placing similar goods, and arranged those

prices at a rate that my judgment and experience warranted me in presenting to customers to be formally considered by them, and such prices were somewhat modified—that is, lowered—on some sizes of the valves, to make the prices more uniform and to conform with my judgment as to their adaptability to the trade. Other prices were kept the same.

(Defendants move the master to strike out the answer of the witness, because founded upon his opinion and judgment rather than upon facts. Denied. Saved.)

Int. 58. You have given us a list of prices established on the organization of the Consolidated Safety Valve Company for farm engines and locomotive valves to railroads, but not for locomotive valves to locomotive builders or for marine and stationary valves. Will you please give such prices.

(Same objection and exception.)

242 Ans. With the locomotive builders we made a special net price, which was some lower than our price to the railroads, so as to allow the locomotive builders a profit in their sales to the roads, and treated them in this matter as special agents. As a sample of these prices we quoted the Hinckley Locomotive Works, $17.50 each net, for a 2¼-inch Richardson locomotive valve not encased. With the Baldwin Locomotive Works we furnished them 2¼-inch valves at $10 each net, with an agreement that in selling to any road which did not have the right to make the Richardson valve they were to pay us a royalty of $10 each, making the price $20 each net. We also made an encased locomotive valve, which we quoted to locomotive builders at $20 each net for 2¼-inch valve. The prices given by me yesterday as the lowest prices we quoted on iron-case valves were the valves usually ordered for stationary and marine boilers.

Int. 59. Did you at any time since you have been engaged in selling pop safety-valves manufacture or offer to manufacture for customers non-adjustable valves—that is to say, valves not furnished with a means of adjusting the relation between the opening and closing pressure, or, in other words, of regulating the reduction of pressure; and, if so, at what time, at what comparative prices as regarded prices of the adjustable valve, and what was the extent of the demand for such valves?

Ans. We did manufacture a locomotive valve, which we termed the old-style Richardson, and did offer it at a price ranging from 10 % to 25 % below our prices for the locomotive valve with the adjustable ring, but our customers preferred to use the adjustable ring to such an extent that we discontinued the manufacture of them. We also made a valve which we termed the Richardson valve for stationary and marine work without the adjustable ring and had no sale for them, and did not complete the full line of patents, and I do not think we sold twenty-five of that type of valves. The demand for the locomotive valve without the adjustable ring was so

limited that we did not even make a cut of it or publish it in our catalogue.

Int. 60. The prices which you have given were, as I understand, the lowest prices at the organization of the company and for six months thereafter. Did you sell at those prices a large or a small part of your product?

243 (Same objection. Saved.)

Ans. We sold a small part of our product at the lowest prices given. The greater part of our sales were at much higher prices than those given by me yesterday. I refer to valves for stationary, marine, and portable engine trade.

Int. 61. Now, from the prices of 1879 you made reductions. Did you make more than one reduction; and, if so, how frequently did you reduce your prices on account of your belief in the competitive lower prices offered to your customers by the Crosby Steam Gage and Valve Company?

(Same objection; and, further, the defendants object to testimony resting upon the belief of this witness as to competition of the defendants rather than the facts. Admitted and saved.)

Ans. I did make more than one reduction. They were very frequent and they were made in order to hold our trade against the competition of the Crosby Company in offering their valves to our customers at a much lower price than they were paying us.

Cross-examination by J. H. MILLETT, Esq., of counsel for defendants:

Cross-int. 62. Please to examine the document to be handed you by the master and state whether it was published by the complainant company, and when.

Ans. I think that was delivered from the printer the early part of 1879. It was the first catalogue published by the Consolidated Safety Valve Company after their organization.

(Defendants offer the identified catalogue in evidence, and it is marked "Complainants' Catalogue of 1879, J. G. S., master.")

(Adjourned.)

JAN. 14, 1886.

Counsel for complainants offers in evidence certified copies of certificates of condition of the defendant corporation as follows:

For the year 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884.

(Defendants object to these copies as inadmissible for any purpose whatever to determine the question which is before the master in this accounting proceeding.)

Certificates admitted and marked with initials of master.

(Objected to and exception saved.)

244 *Testimony of George H. Eager.*

Direct examination by THOMAS W. CLARKE, Esq., of counsel for complainants:

BOSTON, *Jan.* 14, 1886.

Int. 1. Are you the same George H. Eager who appears as a stockholder of the defendant company firm in each year from 1876 till now?

Ans. I am.

Int. 2. What dividends, either as percentage or as amounts per share (put it in whichever form you like) in money or stock, have been paid by that company to its stockholders between Feb. 15, 1879, and Jan. 31, 1885?

(Objected to as inadmissible, as whatever he may say as to other stockholders is wholly hearsay, and any statement of dividends has no bearing upon the question of profits made by the defendant company in the valve business, which is to be determined by the master. Admitted. Objected to. Saved.)

Ans. I couldn't answer at this time.

Int. 3. You are the treasurer of the Crosby Steam Gage and Valve Company?

Ans. I am.

Int. 4. Can you obtain from your own books or from those of the company in your possession the information asked you?

(Objected to as before. Saved.)

Ans. I can.

Int. 5. Will you please do so and report at the next hearing?

(Same objection. Admitted. Saved.)

Ans. I shall not.

(Mr. Clarke notifies Mr. Millett, as president of the Crosby Steam Gage and Valve Company, and Mr. Eager, as treasurer of said company, to produce the records of the board of directors of the Crosby Steam Gage and Valve Company from Feb. 15, 1879, to Jan. 31, 1885, which contain the declaration of dividends during that period, and also Mr. Eager, as treasurer, to produce the books of the company showing the payment of dividends during that time;

245 also all the records of the board of directors during that period in which there appears any action of the board as to fixing the cost or selling prices of valves, and the reports of the superintendent or manufacturing agent as to the cost of manufacturing safety-valves during that time.

Mr. Millett says the officers of the company referred to will consult with their counsel advising and representing them in this proceeding, and, if so advised, will produce them.)

Int. 6. For what reason do you refuse to ascertain and give the information inquired of you about dividends?

(Objected to as inadmissible. Admitted. Saved.)

Ans. The reason I decline is because I think it cannot be required of me.

Int. 7. If any part of your objection arises from the fact that no compensation is offered for the trouble you may be at and you will mention what compensation you would require for the service asked you, I should be pleased to compensate you. Will you please tell me if your refusal arises on this score?

(Objected to. Admitted. Saved.)

Ans. The idea of recompense was not present in my mind.

(Adjourned.)

TUESDAY, *Feb.* 9, 1886.

Mr. Millett says:

As to so much of the complainants' request, to wit—

"Also all the records of the board of directors during that period in which there appears any action of the board as to fixing the cost of or selling price of valves, and the reports of the superintendent or manufacturing agent as to the cost of manufacturing safety-valves during that time" (Feb. 15, 1879, to Jan. 31, 1885)—

Mr. Millett, as president, and Mr. Eager, as treasurer, of the defendant company, in answer to the above request say that they have been members of the board of directors during the interval inquired about, except a few days in the latter part of May, 1881, and that, with the exception of Mr. Eager, who has been absent for a few times, they have been present at all the business meetings of the board;

246 that at none of the meetings have reports been made to the directors by the superintendent or manufacturing agent or any other officer of the costs of safety-valves, nor was there any action ever taken by them in fixing the costs or selling price of safety-valves inquired of, and there have been and are no records of any proceedings in the matter whatever, so that they are unable to comply.

Evidence for Defendants.

Testimony of George H. Crosby.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Oct.* 19, 1886.

Int. 1. In your prior examination in this accounting proceeding do you wish to correct replies to the requests of the complainants given in the fifth and sixth paragraphs of Int. 58? If so, you can now do so.

Ans. I thought that those were in. I find that they were not, and will now reply to a question that I thought I had replied to before. I have prepared a statement showing time used in assembling and adjusting iron valves and in testing and adjusting iron valves, and I produce the same as my answer:

Time Used in Assembling and Adjusting Iron Valves.

Size.	From Feb. 15, 1879, to May, 1880.	May 1, '80, to May 1, '81.	May 1, '81, to May 1, '82.	May 1, '82, to May 1, '83.	May 1, '83, to May 1, '84.	May 1, '84, to May 1, '85.
2″	100 minutes	82	64	56	50	46
2½″	150 "	124	96	85	75.	70
3″	200 "	165	128	113	100	93
3½″	300 "	248	192	170	150	140
4″	400 "	330	256	226	200	186
5″		496	384	339	300	279
6″					600	558

247 *Testing and Adjusting Iron Valves.*

2″	120 minutes	98	76	68	60	56
2½″	172 "	142	110	96	86	80
3″	268 "	220	172	152	134	124
3½″	344 "	284	220	196	172	160
4″	480 "	396	308	260	240	224
5″		660	512	452	400	372
6″					600	558

Int. 2. Please give the cost of the springs which were used in th several sizes of the safety-valves accounted for.

Ans. 1 inch valve spring cost---------- 12 cents
1¼ " " " " ---------- 18 "
1½ " " " " ---------- 25 "
2 " " " " ---------- 40 "
2½ " " " " ---------- 50 "
2½ " " " " ---------- 60 "
3 " " " " ---------- $1 00
3½ " " " " ---------- 1 50
4 " " " " ---------- 2 00
5 " " " " ---------- 3 00
6 " " " " ---------- 4 00

Int. 3. To Int. 37 you have stated that the cost of moulding was seven cents per pound. What proportion of that seven cents is labor?

Ans. Two and one-half cents of that seven cents is labor and is included in the pay-roll.

Int. 4. In answer to Int. 54 you say that the price paid for labor on valves was over 25 cents an hour. What price per hour was allowed in calculating cost of labor in making up the costs of the valves, and how was that price got?

Ans. It was estimated from the actual money paid the men, to which I added a sum for time used when not actually producing and for other small items of cost, not otherwise enumerated at the time, such as bolts and nuts, set-screws, alterations to suit customers, etc. The price per hour allowed was 22½ cents. The additional

sum charged or estimated was 2½ cents per hour, making the total 25 cents per hour.

248 Int. 5. For such labor upon job work what is it customary to charge?

Ans. Fifty cents per hour.

(Objected to as immaterial.)

Int. 6. How long have you been engaged in or connected with the construction of steam-gauges?

Ans. Since 1870 or 1871.

Int. 7. During this time have you been familiar and do you know the relation of labor to the cost of gauges, reckoned in material and labor?

Ans. I do.

Int. 8. Does this familiarity and knowledge extend to the defendants' business?

Ans. Yes.

Int. 9. What has been the relation of labor during the time of the accounting to the cost of gauges in material and labor?

Ans. The labor has been less than 25 per cent. on the average.

Int. 10. What was the character of the defendants' business relative to the kinds of products turned out during the years of the accounting?

Ans. Other than valves, very largely gauges.

Int. 11. Of the gauge manufacture, what is the labor which the defendants bestowed upon the materials procured?

Ans. Drilling a few small holes in case; bending the spring-tube and fitting same; finishing the socket; stamping or printing the dial; assembling and adjusting.

Int. 12. To what class of gauges does this refer, iron or brass?

Ans. Iron. In brass, the finishing of the case and ring is to be added to the above.

Int. 13. In your testimony given in the record in this case, on p. 320, you speak of a Richardson valve. Please examine the valve now handed you and state whether or not that is the one there referred to.

(Valve handed witness is tagged for identification "Richardson Valve, ¾-inch, J. G. S., master.")

Ans. It is.

249 Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 14. Where did you get the information which you gave this morning as a correction or amplification to your answer to Int. 58?

Ans. That was taken from the estimates that I made at the time that the other evidence was given.

Cross-int. 15. Have you in your possession or under your control any estimates made in the years 1879, after February, 1880, 1881, 1882, 1883, or 1884, before Jan. 31, that show the estimated or actual

cost of valves or of the work on valves or of the material in valves during those years respectively?

Ans. No.

Cross-int. 16. What are the other items in the 7 cents per pound cost of moulding, besides the 2½ cents in labor carried in the pay-roll, and how much does each of these amount to?

Ans. Coal, .006¼; charcoal and wood, .002½; power of elevator and blower, .002½; depreciation of metal in melting, .01; direct loss of metal, spattering, spilling, and cleaning, .005; repairs on furnaces and chimneys, .005; use of furnaces, ovens, flasks, troughs, etc., .001; repair of floor, flasks, troughs, etc., .001; machine cleaning and trimming, .01; incidentals, .00175; making a total of 4½ cents.

Cross-int. 17. What part of the selling value of products of the defendants during the period of this accounting, stating year by year, was gauges?

Ans. I couldn't tell.

Cross-int. 18. Not even approximately?

Ans. No, the selling not being under my supervision.

Testimony of George H. Eager.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Oct.* 19, 1886.

Int. 1. In your examination in this accounting do you wish
250 to correct the answer to Int. 22 relating to levers for locomotive valves?

Ans. I do. I said they were plain iron levers by mistake. They were brass.

Int. 2. Since that examination have you examined the schedule marked "General expense account"? If so, have you noticed any error in it?

Ans. I have examined the general expense sheet and wish to make a few corrections.

First, in the item of salaries. In the one already filed Mr. Meady's wages were not included from Feb. 15, 1879, to Jan. 1, 1883. That has now been added. The former schedule included the wages of G. W. Brown. These have now been deducted for the time during which he worked in the factory and added to the pay-roll. The packers' wages, which were included in the item "salaries," have been deducted and also added to the pay-roll.

Another change I wish to make is in the matter of depreciation of assets. My attention was called to that by Int. 79, and the depreciation on patterns has been deducted.

I now produce a general expense sheet embodying these corrections.

(Sheet produced is marked "Corrected General Expense Account, J. G. S., master.")

Int. 3. Do these changes affect the statement already submitted

by you in reply to Int. 168 concerning the pay-roll of the defendants?

Ans. These changes would affect the pay-roll as given by me in answer to Int. 168.

This pay-roll now is made up to exclude Meady's, engineer's, and watchman's wages, and to include the wages of G. W. Brown and the packers, and such corrected pay-roll is herewith submitted.

(Pay-roll submitted is marked "Corrected Pay-Roll, J. G. S., master.")

Int. 4. In your examination of Schedules 16*a*, 16*b*, 16*c*, and 16*d*, relating to account of valves returned, etc., for reply to Int. 110, did you observe errors or not? If so, do you wish to point them out and correct them?

Ans. In my answer to Int. 110 I explained the character of
251 each item borne on these schedules, and some errors were found and pointed out there which I wish now to correct in detail. I have prepared a memorandum of corrections in the schedules referred to, referring to the items as numbered on said schedules, and have annexed a statement of the corrections which should be made in each case, No. 1184 and No. 1199, to make these several schedules correct in fact. I produce this memorandum and make it a part of my answer.

(Memorandum is marked "Memorandum of Corrections in Schedules 16*a*, 16*b*, 16*c*, and 16*d*, J. G. S., master.")

Int. 5. Have you prepared a statement embodying these corrections, so as to show corrected summaries of the accounts filed by the defendants?

Ans. I have, and now submit the same.

(Marked "Corrected Summaries, J. G. S., master.")

Int. 6. In reply to Int. 168 of the list showing materials purchased, you say that among these materials to some extent small supplies were mingled. Will you please state to what extent?

Ans. I have found the amount of small supplies contained in those sums given in answer to Int. 168, and have made a table of the same, which I submit, which corrects the amounts of materials purchased as stated by me in answer to Int. 168.

(Table produced is marked "Corrected Materials Purchased, J. G. S., master.")

Int. 7. Are you familiar with the character of the materials which have been purchased for the products of the defendants?

Ans. I am.

Int. 8. Do you know the relation of labor employed by the defendants to the cost in material and labor in the making of their products?

Ans. I do in a general way.

Int. 9. In the making of the valves what is the character of the material which was purchased during the accounting with reference

to its being raw material or material on which labor had been bestowed elsewhere?

Ans. It was principally raw material.

Int. 10. What was it?

252 Ans. It was pig and ingot metal, except the iron castings and valve springs.

Int. 11. Now, from materials of this sort is the valve product obtained or not?

Ans. Yes; it is.

Int. 12. What is added to the materials?

Ans. Labor.

Int. 13. Was that labor furnished by the defendant company or not?

Ans. It was furnished by the company.

Int. 14. What kind of products, if you know, did the defendants turn out during the years of the accounting?

Ans. From Feb. 15, 1879, until the latter part of 1881, the product was chiefly gauges and valves, gauges predominating largely. During this time other products were being worked up, so that during and after 1882 the other products increased rapidly, and so continued to the end of the accounting.

Int. 15. What are the kinds of things produced besides gauges and valves?

Ans. I should say, in the order of time in which their manufacture commenced, lubricators, chime whistles, and indicators, with smaller things.

Int. 16. What was the condition of the materials for gauges when they were purchased by the defendants as to labor bestowed upon them?

Ans. Most of the materials had had a large amount of labor expended upon them when purchased. In the case of iron gauges the cases were purchased all ready for use except drilling a few holes. The tubing was purchased and the labor of bending and putting in the socket and connecting was all that was bestowed on it. The brass ring was purchased complete; also the movement, the glass, the dial in part or whole, and the hand.

Int. 17. Then upon these materials what was the labor furnished by the defendants to put them into the product for the market?

Ans. They assembled them.

Int. 18. Now, in the making of chime whistles, indicators, and other products besides gauges and valves during the time of

253 the accounting, whether or not the defendants were able to purchase materials partly constructed for the product.

Ans. They did not.

Int. 19. Then, in the construction of those products, whether or not there was a larger proportion of the labor introduced into them than in gauges.

Ans. There was.

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 20. In making these corrections in different items of this account, you have not thought proper to revise the list of the number of valves manufactured, have you?

Ans. We did, but I forgot to mention it. It is on memorandum of corrections in Schedule 16 *a*, *b*, *c*, and *d*.

Cross-int. 21. Read the items.

Ans. In 1184 it is item 70, 17.50; in 1199 it is item 70, 17.50, 2.16, 6.04, 2.50.

Cross-int. 22. These are sales, are they not?

Ans. Yes.

Cross-int. 23. Now, will you tell me whether you have thought fit to revise the list of valves made, which is what I asked you before?

(Defendants object, because in response to the master defendants submitted a statement for complainants which showed in detail, giving dates of sales, names of purchasers, each kind and size of safety-valves made and sold and the price at which each was sold and the amounts of sales made, which statement was represented by the summary of sales given by defendants in their accounts furnished the master, and which statement or which account has not been shown to be incorrect, and therefore they have not been called upon nor have they seen fit to revise facts actually given.

Excluded on the ground that the question calls for the mental operations of the witness, and not as to what he has actually done.)

Cross-int. 24. Do you now, as an accountant and treasurer, think that if a man makes ten safety-valves, sends them all out to
254 customers, five of them are returned by the people who receive them, and then four of the five returned are sold to other parties, the account should be made up that fourteen safety-valves were made, fourteen were sold, and that the difference between the selling price of fourteen and the manufacturing price of fourteen should be taken as the gross profit from which should be deducted the selling price of five to get the net profit?

(Objected to, because whatever this witness may have thought and whatever he may think as to defendants' style of book-keeping is not admissible to charge this company in this accounting.

Question excluded and complainants except.)

Cross-int. 25. I have received information, since I closed my case for the complainant and not before, Mr. Eager, that during the time you have been connected with the Crosby Steam Gage and Valve Company there were submitted frequently to the board of directors estimates of the cost of making valves in order to fix the selling price for the time being; that those costs were in writing and were for some time preserved in the treasury archives of the company. I call your attention to this statement and ask you if you have now in your custody as treasurer or if you ever have had any such papers; and, if so, to produce them.

Ans. I never saw an estimate or statement of costs of valves submitted to the board of directors in writing at any meeting when I was present. I never had such estimates or costs in my possession and have not at this time any such estimates or costs.

Testimony of Matthew Scrannage.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

Nov. 2, 1886.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Matthew Scrannage, of Medford, Mass.; forty-three; brass manufacturer.

Int. 2. State how long you have been engaged as brass
255 manufacturer, and what is your familiarity with the manufacture of brass goods, especially relative to ascertaining their costs.

Ans. I have been engaged in that business twenty-one years last April. I have to give estimates on different kinds of goods, make prices, etc. I have done this since commencing business for myself, in 1865.

Int. 3. Whether or not you have ever seen the Crosby safety-valve made of brass of various sizes for the purpose of ascertaining or estimating the cost of the same?

Ans. My attention was called to the Crosby safety-valve by the Consolidated Safety Valve Company, I believe, in regard to the cost of these valves some time last spring, I think.

Int. 4. Did you see and examine such valves; and, if so, where and in whose company?

Ans. I did see some of those valves, four in number, but where it was that I saw them I can't say. I was taken to the office where they were in company with Mr. Hayden.

Int. 5. Please state whether about that time there was submitted to you what purported to be costs of brass valves made by the Crosby Steam Gage and Valve Company.

Ans. There was, I supposed, a list of the costs of those valves, as near as I can remember.

Int. 6. From whom did you receive that list?

Ans. From Col. Clarke, I believe.

Int. 7. Do you know whom he was representing?

Ans. As far as I could learn, it was the Consolidated Valve Company.

Int. 8. Did you examine into the list of prices with a view to make an estimate upon the costs in comparison with what purported to be the costs as fixed by the Crosby Steam Gage and Valve Company?

Ans. I examined those valves with a view to an estimate of their cost compared with the list as furnished by the Crosby Steam Valve Company.

Int. 9. Did you form an opinion or an estimate then?

Ans. I did; from what I can remember now, that the estimates as given in that list were about right.

256 Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 10. You thought they were fair contract costs, did you not?

Ans. I so informed the Consolidated Valve Company to that effect.

Direct examination resumed:

Int. 11. Has the word "contract" any particular signification in the question which was just put to you?

Ans. None that I can see.

Cross-examination resumed:

Cross-int. 12. You would have been willing to have made the Crosby valves for the Crosby Company in the years of the lists submitted to you for the prices carried on those lists, would you not?

Ans. I shouldn't care to have made them any less, I think.

Direct examination resumed:

Int. 13. What did you understand from the list given you that that cost price embraced?

Ans. The cost of labor and material was all the cost that I had or remember on this list.

(Mr. Scannage's deposition is objected to on the ground that the papers referred to by him have not been identified or sought to be identified.)

Testimony of Joseph L. Hayden.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Nov.* 2, 1886.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Joseph L. Hayden; fifty-five; South Boston; machinist—tool-maker.

Int. 2. Please state how long you have been engaged in the making of tools and for what kind of work you have been making machinery.

257 Ans. All my life; labor-saving machinery is most all I make.

Int. 3. For working what kind of metals?

Ans. More brass than any other; both iron and brass.

Int. 4. State whether or not you have been familiar with the making of brass goods and in estimating their costs.

Ans. I am, because it has been my business.

Int. 5. Whether or not you have examined safety-valves made of brass by the Crosby Steam Gage and Valve Company for the purpose of ascertaining costs?

Ans. I know more about that from the figures that were given me by the Consolidated Valve Company, and examined them pretty thoroughly with Mr. Scrannage, just examined.

Int. 6. When was that?

Ans. This last spring, say six months ago.

Int. 7. Did you see in company with him brass Crosby valves?

Ans. Oh, yes.

Int. 8. Did you also see costs of brass Crosby valves made by the Crosby Steam Gage and Valve Company?

Ans. Yes; I saw what they said was, in writing.

Int. 9. Did you examine those costs and those safety-valves for the purpose of ascertaining their accuracy?

Ans. I did; I was asked to do so and I did so.

Int. 10. What judgment did you arrive at?

Ans. That they were not far out of the way, with the tools and fixtures that they had for making at that time.

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 11. Were those costs in writing or in print?

Ans. Writing.

Cross-int. 12. Did you ever see the printed costs shown on pages 9, 10, 11 of defendants' account (1188), and printed costs on pages 10, 11, 12, and 13, on pages of defendants' account (1199) now shown you?

Ans. I don't say I did; I might have seen them; but it
258 was not what I went by. We didn't see much about iron valves; it was about brass. I didn't see these here enough to make any note about it anyway.

Testimony of Francis T. Simmons.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Nov.* 2, 1886.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Francis T. Simmons; thirty-one; Chicago, Ill.; wholesale hats, caps, etc.

Int. 2. Whether or not you have ever been employed by the Crosby Steam Gage and Valve Company; if so, when?

Ans. I have; from February, 1878, until May, 1886.

Int. 3. During that time what was your duty as an employé?

Ans. That of salesman.

Int. 4. As a salesman, was it your custom to travel in the country?

Ans. It was.

Int. 5. To what extent have you travelled for them as a salesman?

Ans. In all States of the Union, except, I think, two—Texas and Arkansas—and all the Territories, except four—Indian, Dakota, Washington, and Montana.

Int. 6. To what extent did you become acquainted with the trade in the products made and sold by the defendants?

Ans. To the fullest extent compatible with my position.

Int. 7. What were the kind of goods which you were selling during that time?

Ans. All the products of the Crosby Gage Company.

(No Int. 8.)

Int. 9. Did those products include safety-valves?

Ans. Yes.

Int. 10. What classes of customers did you visit for the purpose of selling safety-valves?

Ans. Railroads, farm and portable-engine builders, marine-engine builders, and boiler-makers of all kinds.

259 Int. 11. How extensively did you visit railroads?

Ans. I aimed to visit all of them.

Int. 12. Are you familiar with the kinds of safety-valves in use during the year 1878? State them.

Ans. I am. The common safety-valve, either spring or weight loaded; the Richardson pop valve, the Crosby pop valve, and the Ashcroft valve. Of the latter I knew very little at that time.

Int. 13. Were there any additions to these at about that time? If so, please state them, and the year they came to your knowledge.

Ans. The Kunkle valve came first to my observation in 1879. Since then there have been several—the Orme, the Ashton, the Scoville, the Collier, the Lynde, the Case and Bailey (Detroit), the Lunkenheimer, the Thomas Badgeley and Wentworth valve, the Cowie valve, the King Iron Works valve, Buffalo. Those are all I recall.

Int. 14. Prior to 1879 and during 1879 in what form did you meet the Richardson valve?

Ans. In the then locomotive form, the construction being two studs and a yoke and a spring open without encasement.

Int. 15. Please examine the cut on page 2 of complainants' catalogue of 1879 and state how that compares with the valves you have just described.

Ans. I find it much the same in general appearance, and, as near as I can tell, the same, with the exception of the adjustable ring here shown and the boss, evidently cast on the yoke.

Int. 16. How long, from 1879 onward, was it before you saw any other form of a Richardson valve, so called, in use on locomotives?

Ans. I can't state exactly the time. It was after that time that I began to see them with the adjustable ring, the same external form of valve. I do not remember having seen the boss at any time.

Int. 17. Whether or not you saw, and when, any other modification of the Richardson locomotive valve?

A. I never saw any other modification of the so-called Richardson valve, for the name soon changed to the Consolidated valve.

Int. 18. As such valve, what changes, if any, in it came to your observation?

Ans. The abolishing of the external form of the valve wholly and in its stead an encased valve having a strong resemblance
260 to the Crosby valve and embracing some of its good qualities,

among them notably the convenience of application to the dome cover of a locomotive.

Int. 19. Please examine a safety-valve marked upon a tag attached to it "marked for identification Oct. 19, 1886, Int. and Ans. 13 of George H. Crosby, Richardson valve, ¾ in., J. G. S., master," and state how, in general appearance, it compares with the Consolidated locomotive valve which you have just mentioned.

Ans. In general appearance it is substantially the same.

Int. 20. I making this comparison, whether or not you disregarded size?

Ans. I did. I understood the question to be as to appearance and not size.

Int. 21. About what size was the locomotive valve?

A. Mainly 2½-inch, or with a range of from two inches to three inches, inclusive.

Int. 22. About when did you first see the encased locomotive valve?

A. I can't state positively, but know that the first time I saw it whereby it made an impression upon me was not prior to 1882.

Int. 23. In 1878, when you first began to sell for the defendants, whether or not the safety-valves you sold are represented in "Crosby Catalogue A, Moore, 37"?

Ans. They are represented here on fly-page corresponding to 21.

Int. 24. And the cuts there show what kinds of safety-valves?

Ans. They show the portable or farm-engine valve and the locomotive valve.

Int. 25. Please examine Crosby valve, 1¼ inch, marked for identification "Crosby Valve for Farm Engines, 1¼ inch, J.G.S., master;" also Crosby valve, 1½ inch, marked for identification "Crosby Valve, 1½ inch, J. G. S., master," and state how they compare with the 1¼ and 1½ inch sold by you in 1878 and 1879.

Ans. They are practically the same. There are differences of manufacture, notably at point of connection. The valve of 1878 was with a female thread instead of male; the lever was longer and not nickel-plated like the exhibit, but in all important features
261 was substantially the same. What I have said applied to the 1¼ valves. Nickel-plating was the exception, indulged in for sample valves for special occasions. I find the 1½-inch valve substantially as the valves I sold at that time.

Int. 26. What were the sizes of the locomotive valve sold at that time?

Ans. 2 inch, 2¼ inch, 2½ inch, and 3 inch.

Int. 27. Whether there was any substantial difference in their construction and appearance other than size?

Ans. There was not.

Int. 28. To what extent did you make observations of the use and working of locomotive valves during your employment by the defendants and what were the methods adopted by you?

Ans. To the greatest extent possible, and gained from all sources; principally the observation of the practical working of the valves

as obtained by riding upon locomotives and watching carefully the operation of safety-valves under all circumstances.

Int. 29. In 1878 or 1879, whether or not, if you know, there were difficulties attending the working of locomotive valves? If so, state what these difficulties were and what were the kind of valves giving them.

Ans. I know there were difficulties existing mainly in the use of the Richardson valve as manufactured, and, as there were then only two pop valves in anything like general use, the Richardson would embrace the faulty valve, the faults being, first, that the Richardson valve had a bevelled seat; was loaded by a helical spring which in its action would, in common with all helical springs, cock or deflect, and there being no way of changing the relative location of the valve to its seat the tendency to cock of the spring would cock the valve into its seat and in a short time cause the valve to leak at that point. The dynamic action of the spring would also hammer down the valve seat, so that the effect would be to allow more steam to escape at time of action than was the case when the valve was new and fresh. These, added to the fact that the spring in cold days, in cold climates, was wholly unprotected and subject to intense extremes of heat and cold, caused by the opening of the valve at a time when the spring was as cold as the atmosphere, had
262 a tendency to weaken the spring and cause it to break and render it unreliable; also the unencased spring offered peculiar temptations to engineers to exceed their limits of pressure, they being enabled to block the spring easily and without detection, thereby rendering the valve wholly inoperative, the operation of blocking being simply to stick a piece of wood or a spike between the coils of the spring, thus rendering it incapable of action and locking the valve firmly to its seat.

Int. 30. How long after 1879 did you observe such faults of the Richardson valve?

Ans. Ever and as long as that type of valve existed, which was up to the time of my leaving the employ of the Crosby Company.

Int. 31. Whether or not these faults which you have given can exist in the Crosby locomotive valve; and, if not, please state your reasons.

Ans. I consider it practically impossible and found that they did not exist by actual contact with the valve, the reasons for their not existing being—

First. That the seats were flat, and no matter how much the spring might deflect or cock, the seats being on the same plane, so that when the valve closed the valve would strike on its periphery at a point outside of the seat and immediately come to its seat without damage to itself, as there was enough metal left on the periphery of the valve head to allow sudden contact and consequent indentation to occur without impairing the tightness of the valve.

Second. The seat could never be hammered down; therefore avoiding the change or increase of loss of steam when in action.

Third. The case of the valve so covered the spring as to keep a

more nearly equalized temperature surrounding the spring, acting like an overcoat for it.

Fourth. The spring being thus covered prevented its being tampered with by the engineer and was the feature of the four most commendatory to the master mechanic at the time of offering for trial or sale, he making it a rule to seal the valve after setting it, thereby robbing the engineer of an opportunity to carry more steam than allowed.

263 Int. 32. Were valves, to your knowledge, discarded by railroads on account of the faults which you have just described?

Ans. They were.

Int. 33. For such valves discarded, do you know what valves were introduced in their place? If so, please state.

Ans. I do. The Crosby valve was in many instances, in fact in all instances under my observation, substituted for them.

Int. 34. Was this substitution the result of a mere representation by you as a salesman or as a matter of test?

Ans. Not by my representation, but by actual test of the Crosby valve. I do not recall a case to the contrary.

Int. 35. What size Crosby valves of those given by you were generally adopted?

Ans. The 2½-inch valve.

Int. 36. Is it the locomotive valve represented by the cut in Crosby Catalogue A (fly-leaf)?

Ans. It is.

Int. 37. Do you know the price or cost in 1879 and 1880 to the railroads of the Richardson-valve which you have mentioned above?

Ans. Approximately, yes.

Int. 38. What was it?

Ans. The conditions were various under which this valve was owned by railroads. The only price which I know of was the price at which railroads made their valves and owned them under the shop-right license, which a large number of the railroads had at that time, and my knowledge of the cost is that which was furnished me by master mechanics, varying——

(Further answer giving hearsay evidence objected to.)

Int. 39. At that time, 1879 and 1880, at what price were you selling to railroads the Crosby locomotive valve?

Ans. Twenty-five dollars each.

Int. 40. Do you know whether that price was greater or less than the price to railroads of Richardson valves used by them?

Ans. I do not, of absolute knowledge.

Int. 41. To what extent did the price affect the introduction of the Crosby valve, then?

Ans. To a great extent, the claim being that the Richard-
264 son valve could be made and owned at two-thirds (⅔) less price or approximately that amount, varying in some dollars and cents with different roads.

(Adjourned.)

Nov. 3, 1886.

(Witness says:)

On reflection, with regard to valve price, I wish to amend my testimony in answer to Int. 39. I said twenty-five dollars each. There might have been some times when it was sold for less. I do not recall such cases, but I wish to prevent any error in this regard.

Int. 42. Have you ever known of a Crosby valve having qualities such as you have described to be in use any length of time without repairs? If so, please state how long.

Ans. I have known instances where the Crosby valve has been in use for a long time without repairs, notably in the case of a valve on the Burlington, Cedar Rapids and Northern railroad. That, to my knowledge, was in use more than four years, and remained intact and perfectly operative at the end of four years, and was not even at that time subject to repair.

Int. 43. Please look upon the fly-leaf opposite page 23 of Crosby Catalogue A. Moore 37, and state whether or not you know the person named G. E. Boyden thereon; and, if so, whether or not he is living. Please state also what position he occupied in 1878 and '9 or thereabouts.

Ans. I knew G. E. Boyden at that time or thereabouts to be a master mechanic of the New York and New England railroad, and I understand he is dead at present.

Int. 44. Please examine the list of names given in the answer of Charles A. Moore, complainants' witness, to Int. 23, and state how many of them you introduced the Crosby valve to, and what class of a valve was so introduced.

Ans. I introduced the valve to all except C. Aultman & Co., Aultman & Taylor (properly the Aultman & Taylor Company), Ames Iron Works, Batavia Portable Engine Company, H. & F. Blandy, Ball & Naylor (are not portable engine builders and never were, to my knowledge); J. I. Case & Co., Cooper M'f'g Co.,
265 Harrison Machine Works, Gaar, Scott & Co., Griffith & Wedge, Huber M'f'g Co., D. June & Co., Lane & Bodley Co., James Laffel & Co., Marshall Graves & Co., Charles Perrigo & Co., B. W. Paine & Sons, Peck & Tracey, Porter M'f'g Co., Pitts Agricultural Works, Russell & Co., Reynolds & Lang, M. & J. Rumeley (these people never had a Crosby valve, to my knowledge); J. O. Spencer & Co., Streidler & McNamar, Sinker, Davis & Co., G. Westinghouse & Co., Wood & Co., Eagle Machine Works (never had a Crosby valve, to my knowledge).

Skinner & Arnold are not or were not at the time of my acquaintance with them either farm or portable engine builders; they were boiler-makers. I sold the Crosby valve encased or in its general form, in the different sizes required by these people. Those sizes were called farm-engine or portable sizes.

Int. 45. Of those you introduced the Crosby valve to, please to give the names of those you introduced the valve to prior to February, 1879.

Ans. Stevens, Turner & Burns Co., Taylor M'f'g Co., A. B. Farquhar,

Frick & Co., W. E. Tanner & Co., instead of Tanner & Delaney Co., who later succeeded W. E. Tanner & Co., and were not in existence as a company at the time specified.

Int. 46. What was the period of time during which you introduced the Crosby farm-engine valve to parties other than those just mentioned?

Ans. After February, 1879, up to the time of the last case of introduction, presumably about November, 1883.

Int. 47. What kind of safety-valves were the persons using at the time of the introduction by you of the Crosby valve?

Ans. With very few exceptions, the common safety-valve, either ball or spring loaded, or of that which is known as the spring-balance valve, which consisted of a lever held down by a spring at the outer end and provided with an index and scale, the point of opening of the valve being determined by the tension of the spring as regulated by a screw and nut, commonly called the Salter spring balance, these cases being either that or a modification of it. Up to the time of August, 1878, I had never seen a safety-valve
266 which could be applied to a farm or portable engine with any adaptability except the common safety-valve heretofore described and the Crosby pop valve. In August, 1878, I first saw what was known as the Kunkle valve, which I saw as a sample valve and not in use at that time. The first time succeeding that that I ever saw any other safety-valve than those heretofore mentioned was in the fall or late summer of 1880, when I saw a valve known as the Consolidated valve, which I saw as a sample valve and saw entered in test against the Crosby valve. Since that time I have seen other valves on the pop-valve principle applied to farm engines.

Int. 48. Please to state what these exceptions were, referred to in your last answer.

Ans. The Kunkle and the Consolidated valve, heretofore mentioned; the Lunkenheimer, the Orme, the Scoville valve, the Thomas Badgeley and Wentworth valve, a valve made by the Watertown Steam Engine Company, not strictly a pop valve. These are all that I recall.

Int. 49. Please to give the names of the customers who were using any of the valves you have just named at the time you introduced the Crosby valve to their notice for trial or sale.

Ans. The Watertown Steam Engine Company were using the valve mentioned as the Watertown Steam Engine Company's valve; the Geiser Manufacturing Company was using the Kunkle valve; Pitts Agricultural Works were using the Consolidated valve; the Mansfield Machine Works were using the Kunkle valve. This is all I recall who were using other than the common safety-valve at the time I introduced the Crosby valve to them.

Int. 50. Did you ever visit the persons or firms whose names appear in your answer to Int. 44 as those to whom you did not introduce the Crosby valve?

Ans. I have visited all, with the exception of Charles Perrigo & Co.

Int. 51. What kind of safety-valves were they using when you first visited them as the representative of the defendants?

Ans. They were using in nearly every instance the Crosby valve. H. & F. Blandy were not habitually using a pop safety-valve. J. I. Case & Co. were principally using a spring-loaded common
267 safety-valve. Griffith & Wedge were using principally the common valve. Regarding the Huber Manufacturing Company, I cannot state what they were using, but think they were using the Crosby valve. The Porter Manufacturing Company were using in part Crosby's pop valve and in part the common safety-valve. With these exceptions all were using the Crosby valve at the time I first visited them, to the best of my knowledge and belief.

Int. 52. Please to state, if you can recollect, when you visited these people.

Ans. I cannot state when I visited these people any nearer than to state that it was prior to 1881.

Int 53. How long, if you know, had they been using the Crosby valve?

Ans. I cannot answer that question.

Int. 54. In 1879 you have said that the portable valves which were used were one inch and a quarter and upward. How long after that before other sizes, if any, came into use?

Ans. To my best recollection it was in 1881 that the 1-inch valve came into use to some extent. I have seen a ¾-inch Kunkle valve upon which a question existed as to whether it was properly a ¾-inch valve or not. I have seen them among the first of Kunkle's valves. I also saw at about that time, I think, a 1-inch consolidated valve. Since that time there have been manufactured by the Crosby Company a ¾-inch valve for certain uses.

Int. 55. To what do these sizes refer?

Ans. To the size of the pipe-thread at the connection of the valve with the boiler.

Int. 56. Please examine and state what size the exhibit is which is handed you, marked for identification "Crosby Farm-Engine Valve, J. G. S., master."

Ans. It is a 1-inch valve.

Int. 57. In the introduction of farm-engine valve whether or not trials were made, and, if so, in what way?

Ans. In certain cases trials were made; notably in the late summer or fall of 1880 a trial was had at the shop of C. Aultman & Co., Canton, Ohio, between the Crosby valve and the Consolidated valve of even size and conditions of test as to the efficiency of the
268 valve in action, and as to the relative relieving qualities of the valves and the amount of steam lost in the action of the valves, which resulted in favor of the Crosby valve and the subsequent sale of the Crosby valve to that company for that year, which was made in a contract form covering the needs and requirements of that company for pop valves for every engine of their build for the ensuing year. Notably also at Russell Company's shop, at Massillon, Ohio, the day succeeding the test formerly mentioned in this

answer, a test was had, resulting in exactly the same way as that of C. Aultman & Co.'s, heretofore mentioned.

Int. 58. After 1880 were you accustomed to visit the farm-engine builders whose names appear in Moore's list, which you have already seen?

Ans. I was.

Int. 59. Those whom you introduced the Crosby valve to and those whom you sold it to in that year, 1880, did you retain as customers after that time or not?

Ans. Mainly I retained them. There were exceptions through various causes, notably Russell & Co., whom I lost by being underbid in price in December, 1884, the Crosby valve being supplanted that year by the Consolidated valve; and there were other instances incident to business whereby I lost customers. The case of the Pitts Agricultural Works I also lost—at what year I cannot state at present—through the fact, as represented to me, that my price was higher than that of the Consolidated Valve Company. There was also at that time claimed that there were defects in the Crosby valve which they had discovered, which also had a tendency to discourage their use of the Crosby valve. This at that time I believed to be of no importance, and accepted my defeat as one of price.

The Ames Iron Works discontinued the use of the Crosby valve in favor of the Orme valve—at what year I cannot state—for peculiar reasons existing in the form of the Crosby valve, as they claimed, but, as I understood them, mainly on account of price. In fact I had reason to attribute nearly every interference with the continued use of the Crosby valve to be due to lower prices than I was allowed to make.

269 Int. 60. Please examine the list of names given in the answer of Charles A. Moore to Int. 27 as those of farm-engine builders to whom the complainants sold safety-valves under contracts of the fall of 1884, and state how many of them you had sold valves to as the representative of the defendants, and when and why, if you know, those to whom you sold valves ceased to purchase defendants' valves.

Ans. I have sold valves to every concern mentioned here, with the exception of M. & J. Rumeley and Charles Perrigo & Co., and will state them individually as near as my knowledge and belief will indicate.

Russell & Co.—I cannot state whether they left us prior to 1884, but my best belief is that they continued in the use of the Crosby valve from their initial purchase until 1884, when I lost them, as before stated in answer to Int. 59.

G. Westinghouse & Co.—I cannot state when they ceased. They were intermittent of their purchase of the Crosby valve, vibrating between the Consolidated and the Crosby, the usual reasons being price.

J. O. Spencer & Co. I visited once; cannot state when or why they stopped using the Crosby valve.

Northwestern Manufacturing Company, which should be Northwestern Car and Manufacturing Company, bought the Crosby valve

in conjunction with the Crosby gauge, using the Crosby gauge (the common gauge of commerce known as No. 10 gauge), which proved inefficient, thereby causing trouble and some incident feeling. We were then supplanted by the Consolidated valve, this company returning to the use of the Crosby valve after a year or more; for what reasons I cannot state.

The Pitts Agricultural Works were among the exceptions stated in answer to Int. 59.

J. I. Case and Company never used the Crosby valve, to my knowledge, as their ruling valve, and discontinued use of all pop valves at the time they adopted the Thomas Badgley and Wentworth valve, which was, I am led to believe, partly the invention of Mr. Walrath, the superintendent of their engine department.

Int. 61. Prior to 1879 who, if any one, were competitors of
270 the defendants in the introduction and sale of farm-engine valves, if you know?

Ans. There were no competitors prior to 1879 in the manufacture or sale of a pop valve for farm engines, excepting possibly Kunkle, who was about that time perfecting his valve, but which I never saw in use prior to 1879.

Int. 62. Were the Crosby farm-engine valves in 1879 substantially of the same character and peculiarities as prior to that time?

Ans. They were.

Int. 63. In the introduction of the Crosby valve by you what were the peculiarities which led to a successful use of them?

Ans. Size of the valve, its portability, its ease of application, its durability, as suggested by the fact that there was no ball to swing, no dependent spring at the end of a lever to get out of order; its reliability, from the fact that it was non-tamperable, the troubles of the farm-engine builder being the old valve was cumbersome and in the movable qualities of the engine, it having to be taken from place to place, often under steam pressure, more especially in the class known as traction engines, under any device which they had, and the liability was great of the valves jumping and losing steam whenever the engine passed over any obstacle or rough place. It recommended itself to the builder in that it took especial good care of the engine when such engine was placed in the hands of farmers who were incompetent of judgment regarding over-pressure of steam, it often being the case with a lever valve that the farmer would weight it in excess of its capacity, thereby hazarding both the engine and incidentally the reputation of its builder, it being the custom for the Crosby Company to seal or pin the valve so that it could not be changed as to pressure without destroying a part or the whole fabric of the valve.

Int. 64. Whether or not in the introduction of the Crosby farm-engine valve you found difficulties to be overcome. If so, of what character were they?

Ans. I found difficulties in overcoming the natural prejudice on the part of the farm-engine builder on the points of noise from escaping steam in scaring horses; also a claim, however correctly founded, that the valve, by its sudden relief, would weaken the

271 boiler by its sudden and instantaneous action; in other words, relieve the boiler too quickly. I found the class of men who were building farm engines during the early part of my introduction of the Crosby valve to be mainly ignorant of the theory of steam engineering. They had been threshing-machine builders; therefore the men to whom I went for orders were naturally averse to entertaining anything that suggested complication, and I could not, with effect, talk about the added area and other points relative to pop valves. I found the best policy to be to say as little as might be regarding the hidden qualities of the pop valve, and depended mainly upon the portability and convenience of the Crosby valve in its contained and external form. The size of the valve being no greater than the common valve which it displaced, and which relieved the boiler satisfactorily, it was not necessary to urge the superior relieving qualities of a pop valve, as they were oftentimes in excess of the demand.

I found also inconvenience in that I had frequently to suggest and insist upon locating the valve at a different place, farther above the water line of the boiler than that occupied by the old style of valve. This precaution was necessary in many cases to avoid what is known as drawing water on the part of a pop valve. Therefore, to sum up, I relied more upon the shape and size of the valve than upon its peculiar merits as a pop valve.

Int. 65. After February, 1879, what parties did you find in the market attempting to compete for the farm-engine trade in the sale of valves?

Ans. Up to 1880 I had no competition. During and after 1880 there came into the market, actively, Kunkle, Consolidated, the Orme, and the Lunkenheimer valves—I think in about the order in which the names are mentioned.

Int. 66. When the valves of these parties came to your notice, in appearance how did they compare with the Crosby valves which you had been introducing and selling to farm-engine builders?

Ans. Prior to 1880 there was no peculiarity of appearance, because there were no valves. As they came out in their order they were as nearly like the Crosby valve in appearance as it was possible to make them, and after the change of the Crosby Gage Com-

272 pany in lever, which was changed from the lever like the one shown in Crosby valve for farm engines, 1¼-inch, J. G. S., master, to the one shown in Crosby Catalogue D, Moore 37, in cut, page 37, valve marked "portable and farm-engine style," the consolidated valves very soon after appeared with a change in their lever identical with that of the Crosby, and in every feature possible copied the Crosby form.

Int. 67. Do I understand that your last answer applies in all its statements to the valves made by the complainants during the period from that time on?

Ans. That is the import of my answer.

Int. 68. In the sale of farm-engine valves what other products of the defendants were you accustomed to sell to buyers of valves?

Ans. I was accustomed to sell to the same parties steam-gauges

of the Crosby patent, known as the Crosby improved gauge, which often was sold as comprising a part of what we termed a set, a set consisting of a steam-gauge, safety-valve, and siphon for steam-gauge. These were often bought by customers as representing the tangible evidences of safety, the one being a check upon and indicative of the other's correctness.

Int. 69. In about what proportion did you sell these products together?

Ans. I sold, in nearly every instance, gauges when I sold valves. I sold, in many instances, gauges when I did not sell valves, where the gauge would be used on the same boiler with a competing valve; therefore selling more gauges than valves, but in what ratio of proportion I cannot exactly state.

Int. 70. Whether or not, in the sale of valves, you were assisted by the fact that you could offer a patented gauge which was exclusively under the control of the defendants?

Ans. I was, to a great extent.

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 71. When did you ever see the Scoville valve in use?

Ans. I saw it in use at the shop and on the engines of
273 Christian Kratz, at Evansville. This valve was in use there, and Mr. Kratz, objecting to a pop valve, took the added area out of the valve and said he liked it because it looked like an opera glass.

Cross-int. 72. How many did you see?

Ans. I can't state; a few.

Cross-int. 73. Less or more than a dozen?

Ans. Less.

Cross-int. 74. Did you ever see them more than once?

Ans. Yes.

Cross-int. 75. How many times?

Ans. Probably twice; perhaps more—not in the same month or same six months, but in the same year.

Cross-int. 76. It wasn't a pop valve, was it?

Ans. One of them was a pop valve.

Cross-int. 77. Did you see that twice?

Ans. Yes; a great many times.

Cross-int. 78. Where?

Ans. On the fair ground at St. Louis. That particular valve nowhere else.

Cross-int. 79. That sort of pop valve?

Ans. I stated in one answer I saw it at Evansville, Ind.

Cross-int. 80. Did you ever see that sort of pop valve more than once?

Ans. Yes.

Cross-int. 81. How many times?

Ans. I can't state.

Cross-int. 82. How many places?

Ans. I can't state.

Cross-int. 83. More than two?
Ans. Yes.
Cross-int. 84. Where was the third?
Ans. I can't say which was the third. I saw it in another place, in London, England, in shop of Stevens, Turner & Burns Co.
Cross-int. 85. In what year?
Ans. I can't state.
Cross-int. 86. Do you remember any other time or place?
Ans. I remember other times; cannot positively state place.
274 Cross-int. 87. All in the same year?
Ans. I think not.
Cross-int. 88. What year?
Ans. I can't state.
Cross-int. 89. Before or after 1879?
Ans. After.
Cross-int. 90. Before or after 1880?
Ans. It is my impression that it was not far from 1880; after rather than before.
Cross-int. 91. Before or after 1881?
Ans. My last answer covers that as near as I can.
Cross-int. 92. Before or after 1882?
Ans. My answer stands.
Cross-int. 93. Answer whether you saw that valve before or after 1882, and don't trifle with me.
Ans. I can't state.
Cross-int. 94. Where did you see the Collier valve?
Ans. In Bay State, Mich., at the shop of James Clement & Sons.
Cross-int. 95. In what year?
Ans. I cannot state.
Cross-int. 96. Before or after 1879?
Ans. After.
Cross-int. 97. Before or after 1880?
Ans. After.
Cross-int. 98. Before or after 1881?
Ans. After.
Cross-int. 99. Before or after 1882?
Ans. After.
Cross-int. 100. Before or after 1883?
Ans. After, rather than before.
Cross-int. 101. How many did you see?
Ans. One.
Cross-int. 102. That is all you ever saw?
Ans. Yes.
Cross-int. 103. Was it a pop valve?
275 Ans. I don't know. It was so said to be. I didn't see it in action.
Cross-int. 104. When did you ever see the Lynde valve?
Ans. I cannot state. I saw it at the shop of the Globe Iron Works, Cleveland, Ohio, and in many other places.
Cross-int. 105. In what year?
Ans. I cannot state.

Cross-int. 106. How many did you see at the Globe Iron Works?

Ans. I saw certainly one. I think two. I can't state positively which.

Cross-int. 107. Was it a pop valve?

Ans. I don't know. I saw it externally, and did not see it in action. It was claimed to be a pop valve.

Cross-int. 108. How many did you ever see in any other place?

Ans. I cannot state.

Cross-int. 109. More than one at a time and place?

Ans. I think so. The other places that I saw the Lynde valve were on lake steamers, many of them having two boilers; but I saw the valve so generally that it made no particular or specific impression on me.

Cross-int. 110. When you say in your last answer "many of them," how many do you mean?

Ans. I couldn't formulate a number to represent my impression; less than a dozen, perhaps.

Cross-int. 111. Where did you ever see the Case & Bailey valve?

Ans. I saw the Case & Bailey valve at shop of A. Harvey & Sons, Detroit, Mich. I saw only one valve, and that is all the Case & Bailey valve I ever saw.

Cross-int. 112. In what year?

Ans. I cannot state, nor can I approximate.

Cross-int. 113. Later than 1880?

Ans. I have no idea. The remembrance of the valve is simply an impression with me.

Cross-int. 114. Was that a pop valve?

Ans. I don't know. It was so claimed.

276 Cross-int. 115. When did you first see the Lunkenheimer valve?

Ans. I can't state.

Cross-int. 116. Where did you ever see it?

Ans. I have seen it in his shop, in Cincinnati, Ohio.

Cross-int. 117. Anywhere else?

Ans. Yes.

Cross-int. 118. Where?

Ans. Saw a sample of it in shop of Gaar, Scott & Co., Richmond, Ind.

Cross-int. 119. Ever see it in use?

Ans. I have; have seen it in action, not in use.

Cross-int. 120. Where?

Ans. In the shop of Gaar, Scott & Co. before mentioned.

Cross-int. 121. How many did you ever see?

Ans. I cannot state.

Cross-int. 122. More than two?

Ans. Yes.

Cross-int. 123. How many more than two?

Ans. Fifty, more or less. I might say two hundred, more or less.

Cross-int. 124. Who had them?

Ans. F. Lunkenheimer & Son or Company.

Cross-int. 125. More than one size?

Ans. Yes.

Cross-int. 126. How many sizes?

Ans. I can't state.

Cross-int. 127. What sizes?

Ans. I know that I saw 1¼ inch, 1½ inch, and, I think, 1 inch.

Cross-int. 128. Where did you ever see the Thomas Badgeley and Wentworth valve?

Ans. In their shop, in Milwaukee, Wis.

Cross-int. 129. Anywhere else?

Ans. Yes.

Cross-int. 130. Where?

Ans. In the shop and on the engines of the J. I. Case Manufacturing Company, at Racine, Wis. In the shop of E. P. Allis & Co., at Milwaukee, Wis.

277 Cross-int. 131. How many did you ever see on engines?

Ans. I can't state.

Cross-int. 132. State as nearly as you can.

Ans. I couldn't approximate positively.

Cross-int. 133. Was this a pop valve?

Ans. I don't know—I will state (allow me) it was a pop valve.

Cross-int. 134. Where did you ever see the Cowie valve?

Ans. I don't know that I ever saw the Cowie valve.

Cross-int. 135. Where did you ever see the King Iron Works valve?

Ans. In their shop, at Buffalo, N. Y.

Cross-int. 136. How many did you ever see?

Ans. One.

Cross-int. 137. Was it a pop valve?

Ans. I don't know. It was so represented.

Cross-int. 138. Did you never see in 1879 or before an encased Richardson valve?

Ans. Not to my recollection.

Cross-int. 139. Did you never see in 1879 or before an encased Ashcroft valve?

Ans. Not to my recollection.

Cross-int. 140. You have stated that locomotive valves ranged in size from 2-inch to 3-inch, and you have also stated that you charged for locomotive valves of the Crosby patent $25 each in 1879. Was that the price for all the sizes?

Ans. No, sir.

Cross-int. 141. For what valves did that price rule?

Ans. For the 2½-inch valve.

Cross-int. 142. What was your price for 2-inch?

Ans. Fifty off of list.

Cross-int. 143. In dollars and cents?

Ans. If I can see a catalogue.

Cross-int. 144. What was your price for 3-inch?

Ans. Fifty off of list.

Cross-int. 145. What for 3½-inch?

Ans. Fifty off of list. In many cases which I remember in the

abstract without locating the 2¼ was sold for $25, being loco-
278 motive valve, and to those whose engines were small I saw no reason for quoting anything different for a valve to take charge of the engine. This is more an impression than otherwise, for I have not refreshed myself on that point.

Cross-int. 147. After a series of questions relating to the Richardson valve and before another question relating to the Richardson valve comes Int. 21, "About what size was the locomotive valve?" to which you reply, "Mainly 2½-inch or with a range of from 2-inch to 3-inch, inclusive." Does that refer to the Richardson or the Crosby valve?

Ans. To the Crosby valve, as the Richardson valve was inefficient in comparison with the Crosby valve, and I remember that in placing the 2½-inch Crosby valve I had frequently to order bushings for the dome cover of much larger size, reducing the size of the spring in the dome cover to that required by a 2½-inch in Crosby valve.

(Motion to strike out all after the Crosby valve as irresponsive.)

Cross-int. 148. In answer to Int. 29 you state there were difficulties attending the making of locomotive valves. Who made the difficulties?

Ans. I don't understand the question, "Who made the difficulties?"

Cross-int. 149. Who ever found fault with the bevelled seat to a safety-valve besides you?

Ans. My customers.

Cross-int. 150. Name one.

Ans. I can't name them.

Cross-int. 151. The difficulty arising from the change of temperature in the spring was cured by encasing the spring, wasn't it?

Ans. If not cured, greatly helped.

Cross-int. 152. What railroads discarded the Richardson valve?

Ans. The Chicago, Rock Island and Pacific, Chicago and Alton, Western Union, now a part of Milwaukee and St. Paul, Minneapolis and St. Louis, Chicago, St. Paul, Minneapolis and Omaha, Philadelphia, Wilmington and Baltimore, Cincinnati Southern. These roads and others discarded a valve of the Richardson type. Some
279 of them made their own valves under shop rights. The valves, the rest of them, may or may not have been made by Richardson, but were of the Richardson type of pop valve.

Cross-int. 153. When you say "discarded" do you mean that they took the valves off and junked them or sold them, or do you mean that they ceased to put new ones on?

Ans. Both cases might apply to my meaning of the term.

Cross-int. 154. Which roads, to your knowledge, took Richardson valves off and junked them or sold them?

Ans. I cannot state.

Cross-int. 155. What engines, if any, did Ball & Naylor make?

Ans. I don't remember that I ever knew of them having made

any engines of any types. They are dealers in pumps and plumbers' supplies; also steam-fitting supplies.

Cross-int. 156. Did you ever know a pop valve taken off a boiler and junked or sold and a common safety-valve substituted for it?

Ans. I don't remember any such instance. It would be not unlikely to occur.

Cross-int. 157. You have spoken of competitive trials, at works of C. Aultman & Co. and of Russell & Co., between Crosby and Consolidated valves. Were the valves used in those instances of the same sizes?

Ans. They were.

Cross-int. 158. Were they of the same prices?

Ans. I don't know.

Cross-int. 159. Do you remember at what price you sold Aultman & Co. and Russell & Co. in 1880?

Ans. I do not.

Cross-int. 160. I notice that the book produced called Crosby Catalogue A has on the fly page, following page 20, a schedule of prices from 3 to 3½ inches, all brass. Was that the schedule of prices that you gave 50% off from in 1879?

Ans. Relating to locomotive valves; yes.

Cross-int. 161. I notice on this price-list that the 2-inch valve is priced at $35. What would 50% off of that be?

Ans. Seventeen dollars and fifty cents.

Cross-int. 162. The return made by the Crosby Company of 2-inch valves shows that they sold 49 of these at $18, and 48 at
280 $15 and less. Did you sell any of those that were sold at less than $17.50?

Ans. I don't know; possibly.

Cross-int. 163. Then you gave more than 50% off in those cases, didn't you?

Ans. If I sold any of them, I did.

Cross-int. 164. The 2¼ valve at 50% off would be $20, wouldn't it?

Ans. It would.

Cross-int. 165. It appears from the return of the Crosby Company that 22 out of 61 of the 2¼ valves were sold at $18 and less. Did you sell any of these?

Ans. I don't know; possibly.

Cross-int. 166. Fifty per cent. off of the price of 2½ valves on this list would be $25, wouldn't it?

Ans. It would.

Cross-int. 167. It appears from the return of the Crosby Company that 448 out of 555 2½-inch valves were sold at $23 and less. Did you sell any of these?

Ans. I don't know; probably.

Cross-int. 168. Fifty per cent. off for the 3-inch valve would be $35 on this list, wouldn't it?

Ans. It would.

Cross-int. 169. It appears from the return of the Crosby Company that 78 out of 94 of these 3-inch valves were sold at $32.50 or less. Did you sell any of these?

Ans. I don't know; possibly.

Cross-int. 170. Don't you want to modify your statement that the ruling price in 1879 and 1880 for those classes of valves was 50% off from the list?

Ans. Yes and no; fifty per cent. off was the given price, the standard price, to railroads; as in my modification of my testimony, wherein I said that $25 was the price of a 2½-inch valve, I said in modification of it that there were times and circumstances whereby that price was modified. I was never instructed to sell a locomotive valve for less than 50% off, but when I found and could arrange for an equipment of a railroad, I sometimes saw fit of my own volition to modify the regular price. In the 2-inch valve, as
281 applied to locomotives, the class of engines for which these valves were used were of a narrow gauge or logging species and required a 2-inch valve.

Cross-int. 171. What time in the year 1880 was this test at Aultman's and Russell's?

Ans. In the late summer, in August or September.

Cross-int. 172. Do you remember the prices that you quoted to those parties?

Ans. I do not.

(Adjourned.)

Nov. 4, 1886.

Cross-int. 173. In answer to Ints. 29, 30, and 31 you pointed out what you were pleased to consider defects in the Richardson valve and advantages in the Crosby valve. Do you mean by all that which you have said in answer to those three questions that it is now or ever was your judgment or recollection that a valve which was flat-seated, spring-loaded, and which was not either an adjustable pop valve or a pop valve at all, but whose spring was encased was preferable or preferred to a pop valve or an adjustable pop valve with a bevelled seat, spring-loaded, whose spring was not encased?

Ans. It is now my judgment and ever has been since meeting an unencased valve with the peculiarities described in the question, and having to offer against it an encased valve with flat seats as described, that the advantages of the latter so far transcended the former that it became possible, with a wide difference in price as a strong element to meet, to sell the encased valve, it being as a rule, fully two-thirds higher in price, and I consider that by the advantages thus set forth in the encased valve I was enabled to sell the Crosby valve as generally as I did.

Cross-int. 174. Did you ever sell any safety-valves which were not pop valves?

Ans. I don't remember that I ever did.

Cross-int. 175. I am to understand, then, that you consider the encasing of the spring without a pop action to the valve to be of more importance commercially than the pop action?

Ans. I would not make that which refers to my testimony in regard to an encased spring general for the following reasons:

282 Many valves are placed inside of buildings where there is practically constant temperature. To such this would not apply. But specifically I would say that I did consider at the time of introducing the pop valve to the farm-engine trade that the form of a valve which included, among other useful devices, an encased spring was more to the advantage commercially, as applied to this particular line of cases, than the pop principle as the common valve did, and would perform the offices of safety on farm engines, as the size of the valve ordinarily used was the size that was afterwards used in the pop valve; therefore practically throwing away the advantages which the pop valve yields in being more efficient and disposing of excess steam more promptly.

Cross-int. 176. Were you not aware that the Consolidated Safety Valve Company published an illustrated circular and price-list in the year 1879?

Ans. I do not recall any such circular or price-list; but if such a one existed at that time it is presumable on my part that at that time I knew of it, but it has left no trace of remembrance that I can recall.

Cross-int. 177. Please look at the pamphlet now shown you, complainants' catalogue of 1879, on pages 6, 7, 9, and 14, and say whether or not on those four pages the illustrations show spring safety-valves having the springs protected from the atmosphere and tamperability by encasement.

Ans. As to protection, I would say yes. As to tamperability, I cannot state; presumably, yes.

Cross-int. 178. What was the price at which you offered Russell & Co. valves in 1884?

Ans. I cannot state. I thought I had it before me (looking at a letter). I could find out easily by reference to a letter written after that time upon that subject to the Crosby Company, but without that I cannot state.

Cross-int. 179. Please ascertain whether it was more or less than $2.75 for ¾ and 1 inch valves, $3.00 for 1¼-inch valves, and $3.50 for 1½-inch valves.

Ans. I will try and ascertain at the noon recess and report afterwards.

283 Cross-int. 180. What rule did you have concerning prices of valves in the years of your employment by the Crosby Company, year by year, after the year 1879?

Ans. Rules of discount and rules of net prices, differing according to the valve to be sold.

Cross-int. 181. This gives me the information that you had two sets of rules, one set of rules for one set of customers and another set of rules for another set of customers; but it don't give me the information I asked for, which is what the rules were in each year. Will you bend your mind to that part of the question and answer me?

Ans. I cannot state what they were year by year. I would call them rather methods than rules. It was our custom to confer on

matters of price, and they were varied year by year as circumstances seemed to demand; but what they were and when I cannot state.

Cross-int. 182. Did you in any year have any instructions as to the minimum price which you should exact for valves of different sizes and details of construction?

Ans. My instruction was not in that line; it was more in the line of an established price, and it was tacitly left to my judgment, and appealed to my pride as a salesman to obtain the set price or as near the set price as circumstances would permit. My company evidently did not consider it necessary to be severely dictatorial as to a minimum price.

Cross-int. 183. Did you ever have in any of these years, and, if so, in what year, a schedule or statement of costs or estimated costs given you?

Ans. I never did.

Cross-int. 184. Did you ever make yourself, or cause to be made for your use as a salesman, a schedule or statement or memorandum of estimated costs?

Ans. I tried at various times on certain articles to obtain approximate costs. I obtained through my own research, as near as possible, the cost on a few staple articles upon which competition was closest, notably the No. 10 gauge and the Ammonia gauge, but on showing my cost on the No. 10 gauge it was disputed, and I was always in the dark as to costs beyond my own judgment.

284 Cross-int. 185. What were the defects of the Crosby valve claimed by the Pitts Agricultural Works when you lost their trade?

Ans. I think in my testimony I claimed that the defects did not amount to defects in my estimation, or words tantamount. The case, as I remember it, was that a valve went into the country on an engine to a fair, or, if not to a fair, to a place where a test of the Pitts and one or more rival engines was to be had. The claim, as presented by the superintendent of the engine department, was that one of the officers of the company accompanying the engine was greatly surprised to have a Crosby valve opened at the prescribed point and blow the steam nearly out of the boiler before closing; that he became so enraged that he would not hear of the Crosby valve, but upon my representation that the valve must have had some foreign substance caught between its seat, sand that the valve itself was not responsible for the accident, the point was not urged, and I left hopeful of the contract.

Cross-int. 186. How many Orme valves did you ever see in use?

Ans. A great many.

Cross-int. 187. How many?

Ans. I cannot state how many.

Cross-int. 188. More than a hundred?

Ans. In use and in stock at places where they were used, presumably more than one hundred.

Cross-int. 189. More than two hundred?

Ans. I cannot state; I cannot remember. I saw them generally and without any specific taxing of my memory. I saw them offered

as sample valves and in tests in many of the leading farm-engine shops in the country; also on many steamboats and steam-tugs especially. I saw a great many in Michigan, of iron valves, and experienced more defeat there than in perhaps any other State, owing to the fact that they were offered, or I was so informed, at much lower prices than I could sell the Crosby valve for.

Cross-int. 190. How many sizes of Orme valves did you ever see?

Ans. I think I have seen, in different places and at different times, what would make up a full range of sizes from 1 inch to perhaps 5 inch, inclusive.

285 Cross-int. 191. In what places did you ever see them in use?

Ans. I have seen them in use and in action on tugs on the Chicago river.

Cross-int. 192. How many tugs on the Chicago river?

Ans. I cannot state exactly; say, possibly, a dozen or more.

Cross-int. 193. Where else have you seen them in use or on engines?

Ans. I saw one in use and in action at the shop of the Ames Iron Works, at Oswego, N. Y.

Cross-int. 194. Anywhere else?

Ans. I don't recall any other place at present; presume there were many.

Cross-int. 195. Where did you see them in stock?

Anst. At the Ames Iron Works, Oswego, N. Y.

Cross-int. 196. When you sold a gauge and a valve together, did you make separate prices for the gauge and valve or one price for the two?

Ans. I made a price for the gauge and valve together, but it was generally understood by the customer that, in cases of repair jobs and incident need of duplicate gauges or valves, either the gauge or the valve represented half of the combined price or half the price of a set, so called.

Cross-int. 197. You have said that the set which you sold together consisted of a gauge, a valve, and a siphon for gauge, and also that the gauge and valve were understood by customers to be of equal value in case of repairs. In this equality of valuation which was the siphon hooked on to, the gauge or valve?

Ans. The siphon was always considered by farm-engine builders and the Crosby Company in selling to farm-engine builders a part of the steam-gauge. In my explicit testimony I mentioned the siphon as an after-thought, not putting it in its relative position to the gauge, as I should have, but it was considered to belong to the gauge.

Cross-int. 198. Have you found an answer to the inquiry I put to you this morning?

Ans. I have. I found that I quoted Russell & Co., on Friday, Dec. 5, 1884, 1¼-inch valves at $2.80, 1½-inch valves at $4.00

286 each. I also find that after this quotation, which I think was written, I made a reduction in the price of 1¼-inch valves of

5 cents, making it $2.75, which was, I think, verbal, and was made in hope of taking away the contract on that day.

Direct examination resumed:

Int. 199. Did you get the contract?

Ans. I didn't.

Int. 200. Do you know who did? If so, state.

Ans. I do not know, but am informed it was the Consolidated Valve Company.

Testimony of Ralph W. Foster.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Nov.* 4, 1886.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Ralph W. Foster; twenty-eight; Boston, Mass.; law.

Int. 2. Please state whether or not you have made computations which show the value of material and the value of labor constituting the cost price of material and labor of each size and kind of safety-valve made by the defendants during the several periods of their accounting; if so, please to produce such computations as a part of your answer.

Ans. I have. I produce them.

(Computations produced, marked "Foster Computations No. 1, Material and Labor of Costs of Single Valves, J. G. S., master.")

Int. 3. From what source did you gather the ideas which enter into your computations, and under whose directions did you make them?

Ans. I made those computations under the direction of and from data furnished by Mr. J. H. Millett.

Int. 4. Please to state whether or not you have, under like circumstances, made a computation showing the totals of material and labor in all the valves enumerated in the printed account of the defendants for the periods thereof; if so, produce it.

287 Ans. I have, and I produce it.

(Computations produced, marked "Foster Computations No. 2, Material and Labor in all Valves, J. G. S., master.")

Int. 5. How was the result obtained?

Ans. By multiplying the items of material and labor entering into each valve by the number of valves.

Int. 6. Please to state whether or not you have under like circumstances made other computations for the periods of the accounting, showing the results of the value of labor in the costs as found in the sales of the valves and other products; if so, please produce such computations.

Ans. I have, and I produce them.

(Computations last produced marked "Foster Computations No. 3, Value of Labor as Returned in Sales, J. G. S., master.")

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-Int. 7. How did you get, in computation No. 2, the numbers of valves made? Did you take them from the defendants' account or did you take them from defendants' account of valves sold after deducting from valves sold the particular valves which were not sold but returned and charged off?

Ans. I got them from Mr. Millett, as I did all the data from which my computations were made.

Cross-Int. 8. Then the computation No. 3 follows and is based upon computation No. 2?

Ans. It is.

Cross-Int. 9. So that if there are any errors in the number of valves contained in computation No. 2 those errors are carried forward and magnified in computation No. 3?

Ans. They are carried forward.

Cross-int. 10. I notice in your computation No. 3 you call it an application of complainants' theory to find return of one dollar of labor in sales of products, as shown in Schedules E and F. Why didn't you apply the complainants' theory, which consisted in getting these things into percentages and comparing percentages?

Ans. I wasn't so requested.

288 Cross-int. 11. Please look at Schedule E, on pages 65 to 68 and tell me if the percentages of labor and material used in valves are not in every instance for every period carried out.

Ans. The percentages are there given and appear to be the result of computations.

Cross-int. 12. You didn't either consider it worth while to consider and work out, according to the scheme presented on pages 69 to 73 of Schedule F, that part of the scheme which is contained in the letter-press subsequent to the tabulation and figures?

Ans. I had no thought about the wisdom of such an operation and didn't perform any such operation.

Testimony of George H. Eager.

(Resumed from page 254.)

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Dec.* 28, 1886.

Int. 26. Please examine the list of names given in answer to Int. 44 by Francis T. Simmons, page 392, and state how many of these were defendants' customers Feb. 15, 1879.

(Objected to as immaterial to any issue in this accounting. Admitted; but the master does not now pass upon the materiality of the evidence sought by the question.)

Ans. C. Aultman & Co., Aultman & Taylor Company, H. & F. Blandy, J. I. Case & Co., Cooper Manufacturing Company, Gaar,

Scott & Co., Griffith & Wedge, B. W. Payne & Sons, Russell & Co., Reynolds & Lang, J. O. Spencer & Co., G. Westinghouse & Co.

Int. 27. Of the remainder of this list, when did the defendants first sell to them the Crosby valves, as appears in the list of buyers of Crosby valves which was furnished by the defendants in this accounting proceeding?

289 Ans. Ames Iron Works, Dec. 27, 1879; Balavia Portable Engine Company, May 22, 1879; Ball & Naylor, Jan. 16, 1884; Harrison Machine Works, March 21, 1879; Huber Manufacturing Company, Dec. 17, 1879; D. June & Co., April 16, 1880; Lane & Bodley, April 13, 1880; James Leffel & Co., July 10, 1880; Marshall, Graves & Co., May 10, 1880; Charles Perrigo & Co., March 13, 1879; Peck & Tracey, April 14, 1880; Porter Manufacturing Co., Nov. 21, 1881; Pitts Agricultural Works, Sept. 22, 1882; Scheidler & McNamar, Jan. 19, 1880; Sinker, Davis & Co., April 29, 1880; Wood & Co., Jan. 21, 1880; Eagle Machine Works, Feb. 11, 1884; Skinner & Arnold, April 12, 1881.

Int. 28. According to the list of purchasers spoken of, when did the defendants first sell, after Feb. 15, 1879, to the persons given in answer to Int. 26?

Ans. C. Aultman & Co., Feb. 24, 1879; Aultman & Taylor Company, March 13, 1879; H. & F. Blandy, April 19, 1881; J. I. Case & Co., June 16, 1882; Cooper Manufacturing Company, Dec. 22, 1879; Gaar, Scott & Co., Dec. 11, 1879; Griffith & Wedge, June 26, 1880; B. W. Payne & Sons, April 18, 1879; Russell & Co., April 9, 1879; Reynolds & Lang, April 9, 1879; J. O. Spencer & Co., June 3, 1880; G. Westinghouse & Co., March 22, 1879.

Int. 29. To whom of the farm-engine builders were the defendants selling safety-valves after Feb. 15, 1879, and during that year, under contracts entered into between the defendants and these persons prior to Feb. 15, 1879?

Ans. Aultman & Taylor Company.; C. Aultman & Co.; Russell & Co.

Int. 30. According to the list furnished, how many valves were sold to each of these concerns during that time?

Ans. Under those contracts there were sold to Aultman & Taylor Company 168 valves 1¼ inch; to C. Aultman & Co., 270 valves 1¼ inch; to Russell & Co., 156 valves 1¼ inch.

(The Crosby valve, which defendants produced in July, 1885, at request of complainants' counsel, is put in evidence by defendants and marked "Defendants' Exhibit Crosby Valve, 1¼ in., 1885, J. G. S., master.")

290 Int. 31. Please examine Crosby valve, 1885, and state how that compares with Crosby valves made since Jan. 31, 1885, so far as the feature of adjustability is concerned.

(Objected to, as such valves are not within the accounting, and the business of the Crosby Company since 1885 is not before the master. Admitted, *de bene*, to be dealt with, if necessary to do so, in the master's report. Complainants, without excepting to the

admission of the evidence *de bene*, reserve the right to except when the evidence is dealt with, if the evidence is allowed to have weight. Defendants reserve the right to except when the evidence is dealt with.)

(Adjourned.)

DEC. 29, 1886.

Ans. It is the same.

Int. 32. What effect did the change from adjustability to non-adjustability in the Crosby valve have upon the business of the defendants therein?

Ans. It had no effect. We filled our contract orders and new orders with the non-adjustable valve without complaint. We were able to and did extend our trade in valves.

Int. 33. During your connection with the company from 1879 down to 1885, whether or not from the users of the Crosby valves there came to the defendant company any knowledge of the use of the adjustable feature by the purchasers of such valves.

Ans. I never knew of the use of the adjustable feature of a Crosby valve by a customer. We have had valves returned for repairs and otherwise, after years of use, with the same adjustment which they originally had when they left our factory.

Int. 34. In the case of railroads, to whom great numbers of valves were sold, according to the sheets presented here, whether or not you know that the adjustability of such valves was an essential feature with them; and also please state what was the usage in the making and setting for pressure of such valves.

Ans. The adjustable feature was not an essential one in the case of railroads who, in ordering valves, always stated the pressure at which they were to be set, which was a standard pressure, and never altered.

Int. 35. What was the kind of traffic in the Crosby valves
291 by the defendants in this: whether or not they were made and sold generally or subject to specific orders?

Ans. Specific orders. I mean to say that our business is an order business.

Int. 36. In this order business spoken of what, as a rule, was required by the defendants and advertised in their catalogues during the time of this accounting relative to pressures at which safety-valves were to be set?

Ans. We required the pressure at which the valve was to be set in every case to be stated to us by the customer.

Int. 37. Whether or not any valves during this time ever went out from the factory of the company unless they were set and adjusted to such required pressures.

Ans. They were not.

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 38. Which of the persons, firms, and corporations enumerated in your answer to Int. 26 bought bills of goods on the 15th of February, 1879, and what were their bills of valves?

Ans. I couldn't state positively that any of them bought goods on Feb. 15, 1879.

Cross-int 39. When did you first sell any safety-valves to either of the concerns named in answer to Int. 26, and how many valves, and at what dates and times before Feb. 15, 1879, did you so sell them safety-valves?

Ans. I couldn't at this time state all the times at which safety-valves were sold to these several parties.

Cross-int. 40. Please obtain and furnish the information inquired of in the last question. Will you do so?

(Objected to, unless the complainants will pay the expense of getting the information.)

Ans. I will.

Cross-int. 41. When were the several contracts made with Aultman & Taylor Company, C. Aultman & Co., Russell & Co., referred to in answer to Int. 29?

Ans. The contract with C. Aultman & Co. was dated Sept.
292 25, 1878; with Aultman & Taylor Co., Oct. 28, 1878; with Russell & Co., Dec. 17, 1878.

Cross-int. 42. To what extent, as regards new customers, were you able to extend your trade in non-adjustable valves over what it had been in adjustable?

Ans. I couldn't state at this time exactly, but we obtained new customers in several instances.

Cross-int. 43. Please state the new customers which you obtained with your non-adjustable valve during the year 1885 and the numbers and sizes purchased and the prices obtained for each size in each instance.

Ans. I will endeavor to and will furnish a statement.

Cross-int. 44. Did the railroads state in ordering valves the amount of pressure which it was desirable to lose when a valve blew, or was that left to the judgment of the manufacturer?

Ans. I never knew a railroad to give instructions upon that point.

Cross-int. 45. When it was discovered that the Crosby valve was an infringement of the Richardson patents how long was it before you reorganized it into the form shown in Defendants' Exhibit Crosby Valve, 1½ in., 1885?

Ans. It was done immediately, no time intervening, or as quickly as the mechanical changes could be made.

Cross-int. 46. Prior to Jan. 19, 1885, had you considered in your company the adjustable feature of the Crosby valve of any importance?

Ans. Nothing more than as a shop convenience.

Cross-int. 47. Why, then, among the claims for merit in a locomotive pop safety-valve, on page 32 of your catalogue, did you say "Both the points of opening and closing may be changed without removing the valve or reducing steam in the boiler"?

Ans. I presume it was a point that could be talked of in trade, but of less value than the fact that it was self-contained in a case and could be connected in five minutes.

Cross-int. 48. Why, then, on page 34, did you give directions for "Adjusting.—First screw the ring down as far as it will go; then screw down the nut which compresses the spring until the valve opens slightly at the pressure desired, as indicated by the
293 steam-gauge; then screw up the ring slowly until the valve pops. If the loss by relief is too great, screw the ring down slightly until the loss is the exact number of pounds desired, and then fasten by the set-screw"?

Ans. In our earlier catalogues having called the valve "adjustable," we thought necessary to give directions as to the use of the adjustable feature. These minute directions in the hands of ignorant engineers often caused trouble, and later, by circulars and modifications of these directions, we drew away the attention from the manipulation of this adjustable feature and only directed as to changing the pressure of the valve, to use the head bolt for increasing or diminishing the pressure, saying nothing about the ring.

Cross-int. 49. Please produce any circular or letter that modified these directions about adjustability which was published before Jan. 19, 1885, stating to whom such circular or modification was published.

Ans. I call attention to "Notice C," which was published long before that. It was sent out with every stationary valve, and I guess with every other. It was sent out generally to our customers.

Cross-int. 50. When was it first published?

Ans. I couldn't state the time.

Cross-int. 51. About when?

Ans. To the best of my judgment, two years before the decision—before Jan. 19, 1885.

Cross-int. 52. Did you cancel in your catalogues the instructions quoted or other similar instructions before Jan. 19, 1885?

Ans. I couldn't say whether we did or not.

Cross-int. 53. You have no recollection of doing it, have you?

Ans. Personally I never had anything to do with making up the catalogue except changing the catalogue to conform to the changed conditions of the valve, due to the decision of the court.

Cross-int. 54. That change involved the erasure of the directions quoted and other similar directions, did it not?

Ans. It involved the erasure of the directions quoted. It did involve the erasure of the quotation from page 34. As to this other, on page 32, I cannot state without reference to the catalogue in question.

294 Cross-int. 55. Did it not also involve the erasure of these words, on page 34, "The point of closing is as easily adjusted by screwing up or down the ring surrounding the outside shell or body of the valve," and these words, on page 35, "If, after resetting, the valve fails to 'pop' screw up the ring G. If the loss by relief is too great screw it down slightly until the reduction of pressure, as indicated by the steam-gauge, is the exact number of pounds desired"?

Ans. It involved either their erasure or modification.

Cross-int. 56. When you say "modification" you mean, do you

not, the complete elimination of any allusion to the movableness of the ring?

Ans. I do.

Direct examination resumed:

Int. 57. Please give the whole of the quotation on page 32 of the catalogue referred to in cross-int. 47, commencing with "our claims" and ending with "features in a safety-valve."

Ans. (Reading:) Our claims for merit in a locomotive pop safety-valve are as follows:

1ST, SAFETY. Our valve will discharge more steam than any other, *and will never stick on its seat.*

2ND, ECONOMY OF STEAM. It will close with the least reduction of pressure, and both the points of opening and closing may be changed without removing the valve or reducing steam in the boiler.

3RD, ECONOMY OF TIME AND LABOR. It can be connected in five minutes, is always in good condition, *and is warranted to outwear any locomotive boiler, with no cost whatever for readjustment or repair.*

These claims embrace the main desirable features in a safety-valve.

Int. 58. Please quote in full the Notice C, referred to in your answer to cross-int. 49.

Ans. (Reading:)

NOTICE.

This SAFETY-VALVE is set at — pounds. It should be opened each day by the lever to show that it is in good working order.

295 IT SHOULD NEVER BE MEDDLED WITH FOR ANY OTHER PURPOSE UNLESS IT BECOMES NECESSARY TO RESET THE VALVE.

In such a case first slack up on the jam nut, then screw the head bolt down or up for more or less pressure until the valve opens at the desired point, as indicated by the steam-gage.

CROSBY STEAM GAGE & VALVE CO.

Cross-examination resumed:

Cross-int. 59. When you got out the valves like Defendants' Exhibit Crosby Valve, 1½ in., 1885, you made for that class of valves a special notice, did you not, like that shown on direction tag marked "B, J. G. S."?

Ans. My impression is that when the change was made the last paragraph, marked "N. B." on this tag, was added about that time. All previous had been sent out with the valves before that time.

Cross-int. 60. That is the clause which states "If any greater change than ten or fifteen pounds above or below what the valve is originally set at is required send for a new spring, stating size of the valve and pressure required," is it not?

Ans. That is what I meant to include; that means that a valve

will work properly throughout the full range of a spring, from twenty to thirty pounds.

Cross-int 61. After the decision of the Supreme Court had enjoined the adjustable feature of the Crosby valve did you take any pains, and, if so, what, to make known to the customers whose previous orders you were filling, or to the persons whom you solicited for new trade, that the Crosby valves theretofore advertised as adjustable would for the future not be adjustable?

Ans. We did all that we thought necessary, as has been shown in previous answers, regarding catalogues, etc.

Cross-int. 62. You have stated all you did, have you, in that behalf?

Ans. I don't think of anything else.

Direct examination resumed:

Int. 63. What do you mean by "etc." in your answer to cross-int. 61?

296 Ans. I don't know that it means anything.

Int. 64. Weren't there other things done than merely changing catalogues relating to the changed valve; and, if so, what?

Ans. The word "adjustable" was stricken out of all stationery, bill-heads, and every place it was printed on matter to be sent to customers.

Int. 65. During this time, after January, 1885, whether or nor the defendants advertised safety-valves; if so, in what form, and how?

Ans. We did advertise safety-valves without adjustable features in every case where we advertised—notably the Railroad Gazette. There were several such advertisements.

Int. 66. Whether or not there was any change in the usage of the defendant company in its method of publishing to the world its products after January, 1885?

Ans. In all advertisements the word "adjustable" was left out in connection with valves. We made special efforts to let the trade know that we were manufacturing safety-valves as formerly—that is, that we were in the market as manufacturers of safety-valves.

Int. 67. Why did the company make these special efforts?

Ans. Because of the advertisements of the Consolidated Safety Valve Company setting forth that the Crosby Steam Gage and Valve Company were judged infringers of the Richardson patents, and had been perpetually enjoined.

Int. 68. Please produce an advertisement referred to and make it a part of your answer.

Ans. I produce it, as follows:

297 Charles A. Moore, pres. Martin Luscomb, treas.
Geo. W. Richardson, sup't.

THE CONSOLIDATED SAFETY VALVE CO.

CAPITAL, $100,000.

MANUFACTURERS OF THE ONLY

Solid Nickel Seated Safety Valve

and approved by U. S. Board of Supervising Inspectors.

Adopted by U. S. Navy on all the steel cruisers.

NOTICE.

[CUT] Our patents have been fully sustained by the U. S. Supreme Court, Washington, D. C., and by decision of January 19, 1885, we were awarded profits and damages and a perpetual injunction against the Crosby Steam Gage and Valve Company for infringements of our patents. [CUT]

Send for Illustrated Catalogue.

Salesroom: 111 Liberty street, New York.

Works: Boston, Mass.

Testimony of John C. Hoadley.

Mr. CLARKE, of counsel for complainants, assents to the following:

This examination of Mr. Hoadley having been, on account of his sickness, prepared and presented by him away from the magistrate and opposing counsel and then submitted to counsel as if taken before the magistrate and due notice given, which examination begins on this page and ends on page 309, containing table XI, concluding thus: "No. 244; warn, 149.5; pop, 150; close, 144.5; reduction, lbs., 5.5; per cent., 3.7, twice; mean reduction, lbs., 4; per cent., 2.9," is objected to, question by question and answer by answer, as irrelevant and incompetent on any issues involved in this accounting, and also on the following ground: that if the answers vary or are intended to vary anything contained in the judgment of the Supreme Court, the inquiry is too late, and if they are intended to show that the valve described in the Richardson patent is a bad valve or the valve described by Webster is a good one, this is not competent before the master at this stage and after the judgment.

All the experiments with new Crosby valve without ring are objected to because no such valve and no description of such a valve was in the case at rules.

298 All the experiments with the Defendants' Exhibit Webster Valves, Figs. 1 and 3, are objected to because no such valves were in the case at rules. The same objection applies to the Richardson valves, now introduced for the first time.

The evidence as to Crosby valves is objected to because nothing is said in it about the springs employed in the tests.

This examination may be received as if given by Mr. Hoadley under oath before the master and as if taken question by question and answer by answer, all other objections except those of form being saved to complainants.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

Int. 1. Please examine Defendants' Exhibit Richardson Valve like photo-lithograph drawing and state whether or not you have measured the parts thereof and tested its action under steam; if so, please give their dimensions and the result of your observations in testing the said exhibit.

Ans. On the eighteenth day of March, A. D. 1885, I carefully measured and verified all the essential dimensions of Defendants' Exhibit Richardson Valve like photo-lithograph drawing, a safety-valve made according to the proportions said to be set forth in patent No. 58294, dated Sept. 25, 1866, granted to George W. Richardson, as the same are set forth in actual dimensions and ratios in the testimony of Charles W. Forbes, an expert witness called by complainants, to be found on pages 332, 333 of Record, as follows:

(1.) Diameter of steamway	1.34 in.
(2.) Diameter of valve inside the lip forming the stricture	1.96 in.
(14.) Overlap of lip *c* of the valve below upper outer edge of valve seat E	.025 in.
(15.) Proportion this overlap, as represented in drawings, bears to width for passage of steam between inner edge of lip *c* and outer cylindrical surface of valve seat E	5 to 2
(16.) Average circumference of space between extended valve head and edge of lip *c*	6.126 in.
299 From the above circumference (16) we obtain the corresponding diameter, viz.	1.95 in.

This diameter is .01 in. less than the diameter of valve inside of the lip forming the stricture, and this difference of .01 in. between the diameters gives the width of the stricture. The foregoing dimensions agree with my own measurements of the same parts from a photo-lithograph reproduction of Richardson's drawing, forming part of a certified copy of Richardson's patent of 1866, from the Patent Office.

I have also found the dimensions of the respective parts of said safety-valve, which I measured and verified on March 18, 1885, to agree severally with Mr. Forbes's dimensions above given.

On Wednesday, March 18, 1885, between the hours of 3 and 6 o'clock p. m., I made thirteen experiments with the safety-valve above described, namely, six experiments with an "ordinary spring," noted as such, four experiments with a "weak spring," noted as such, and three experiments with a "strong spring," noted as such.

The essential description and the results of these experiments are arranged in the following table:

TABLE I.

No. of experiment.	Kind of spring.	Compression of spring.	Pop at lbs. per sq. in.	Close at lbs. per sq. in.	Reduction, lbs. per sq. in.	REDUCTION, PER CENT. Single.	Mean.	Grand mean per cent.
1	2	3	4	5	6	7	8	9
1	Ordinary	0.31″	96	69	27	28.1	27.6	
2	"	0.31″	95.5	69.5	26	27.2		
3	"	0.40″	118.5	83	35.5	30	29.3	
4	"	0.40″	119	85	34	28.5		
5	"	0.27″	82	60	22	26.8	26.8	27.9%
6	"	0.27″	82	60	22	26.8		
7	Weak	0.35″	81.5	59	22.5	27.6	27.6	
8	"	0.35″	81.5	59	22.5	27.6		
9	"	0.29″	70	50.5	19.5	27.9	27.9	27.8%
10	"	0.29″	70	50.5	19.5	27.9		
11	Strong	0.30″	143	103	40	28	27.6	27.6%
12	"	0.30″	142	103	39	27.5		
13	"	0.30″	141	102.5	38.5	27.3		
					Mean of all			27.8%

Int. 2. Please examine Defendants' Exhibit Valve Head like photo-lithograph drawing, without overlap, and state whether or not you made any tests of the defendants' exhibit mentioned in
300 the preceding interrogatory, modified by the introduction of this exhibit in the place of the valve head there shown; if so, please state the result of your tests.

Ans. On Jan. 20, 1886, I made experiments with the above safety-valve, except that for the valve proper having its lip overlap the extended seat as already described I substituted a valve having its lip so cut off that its lower edge was on the same horizontal plane with the extended valve seat, as shown in defendants' exhibit now inquired about. A direct-acting spring of $\frac{3}{16}$-inch steel wire—outside diameter, $1\frac{1}{4}$ inch; inside diameter, $\frac{3}{4}$ inch; length, free, 3.10 inch; compressed to pop at one hundred lbs.; length, 2.75; compression for 100 lbs., 0.35 inch—was used. The results of these tests are found in table II:

TABLE II.

No. of experiment.	Overlap .000	Warn, lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	REDUCTION. Lbs. per sq. in.	Per cent. Single.	Mean.
1	2	3	4	5	6	7	8
301	.000		100	99.25	0.75	0.75	
302	"	99.5	100	99.25	0.75	0.75	
303	"	99.5	100	99.25	0.75	0.75	0.75
304	"	99.5	100	99.25	0.75	0.75	
305	"	99.5	100	99.25	0.75	0.75	

On the same day I made the following experiments with the original valve (restoring the valve proper), using the same spring—that is, I used the same valve seat, same spring—but with a valve having .025″ overlap and .01 stricture, according to Richardson's patent of 1866, as above described.

TABLE III.

No. of experiment.	Overlap, in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	REDUCTION. Lbs. per sq. in.	Per cent. Single.	Per cent. Mean.
1	2	4	5	6	7	8
306	.025	100	71.5	28.5	28.5	28.6
307	"	101	72	29	28.7	

Int. 3. Please examine Defendants' Exhibit Richardson Valve from original drawing, 1866, and state whether or not you have measured its parts and compared them with the corresponding parts as shown in the certified copy of the original drawing of a safety-valve in Richardson's patent of 1866, introduced into this case; if so, please give your measurements and state the results of any tests which you may have made with said exhibit to determine its practical operation.

301

Ans. On Dec. 21, 1885, I measured a safety-valve which is the exhibit inquired of, made exactly according to dimensions previously measured by me from a tracing forming part of a certified copy of Richardson's patent of 1866, as follows:

(1.) Diameter of steamway	2.25 in.
(2.) Diameter of valve inside the lip forming the stricture	3.260 in.
(14.) Overlap of lip *c* of the valve below upper outer edge of valve seat E	0.030 in.
(15.) Proportion this overlap, as represented in this drawing, bears to width for passage of steam between inner edge of lip *c* and outer cylindrical surface of valve seat E	Ratio, 5 to 2.7
(16.) Average circumference of stricture in middle of its width	10.1913 in.
Horizontal area of stricture circumference and width	0.16306 sq. in.
Diameter of upper outer cylindrical surface of extended valve seat	3.228 in.
Widths of stricture, equal to one-half the difference between inside diameter of lip *c* and outside diameter of extended valve seat E: $\frac{3.260-3.228}{2}=0.016$	0.016 in.

or, expressed in common fractions, $\frac{1}{64}$ in.

The safety-valve above described was fitted with a lever and spring, as set forth in Richardson's said patent. The length of the short arm of the lever was about 2.75 inches, the length of the long arm about 24.75 inches, both measured from the fulcrum. The leverage was therefore 9 to 1.

The spring made from No. 7 wire was equivalent to 0.32 inches compression directly over the valve.

302 Six experiments were recorded with this valve and spring Dec. 21, 1885, all with the same result. These experiments I designate as No. 55, No. 56, and No. 57.

Experiments No. 55, 56, 57, Dec. 1, 1885; Richardson patent of 1886; 225 inches steamway, exactly according to patent drawing:

Warn at 97 lbs; pop at 100 lbs; close at 68 lbs; reduction 32 lbs. = 32 per cent.

On Dec. 22, 1885, I again tried this valve, with another and a stronger spring, made of No. 6 wire, equivalent to 0.215 in. compression directly over the valve. These tests I call experiments Nos. 58, 59, 60.

DEC. 22, 1885.

	No. 58.	No. 59.	No. 60.
Warn at		97	96
Pop at	100½	99	100
Close at	71	70	71
Reduction, lbs.	29½	29	29
Reduction, per cent.	29.3	29.3	29.0

Int. 4. Whether or not you made any tests with the same exhibit, except that you substituted a valve head having no overlap but otherwise the same; if so, please describe the substituted valve and the tests made.

Ans. I did; the valve used had the same steamway, valve seat, lever, springs, and appurtenances belonging to the said exhibit, but another valve was fitted to the same seat, having its lip *c c* so reduced in vertical width as to terminate at the level of the extended valve seat. This valve I produce and call it "valve head without overlap."

On Dec. 22, 1885, I made ten experiments with this valve (no overlap) with two springs and a lever. One of the springs was the same as the one used in experiments Nos. 55, 56, and 57, above, and is designated as "spring No. 7 wire;" the other is the same as was used in experiments Nos. 58, 59, and 60, and is designated as "spring No. 6 wire." This is a stronger spring.

The result of these tests is found in table IV.

303 TABLE IV.

No. of experiment.	Kind of spring.	Extension of spring.	Warn, lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	REDUCTION. Lbs. per sq. in.	Per cent.	
1	2	3	4	5	6	7	8	9
	No. 6							
61	wire.	1.50	95	100	94	6	6.0	
62	"	1.50	95	100	94.75	5.25	5.25	
63	"	1.50	95	99.5	94.5	5	5	5.25
64	"	1.50	95	100	95	5	5	
65	"	1.50	95.5	100	95	5	5	
	No. 7							
66	wire.	2.63	94.5	100	94	6	6	
67	"	2.63	94.5	100	94	6	6	
68	"	2.63	94.5	101	94	7	6.9	6.1
69	"	2.63	95	100.5	94.5	6	6	
70	"	2.63	95	100	94.5	5.5	5.5	

Int. 5. Please examine Complainants' Exhibit Webster Fig. 1 and Fig. 3, introduced in this case, and state whether or not you have measured the several parts thereof and subjected the said exhibit to practical tests; if so, please give their dimensions and the result of your trials.

Ans. On the fourteenth day of December, 1885, I made a number of experiments with an exhibit designated as Complainants' Exhibit Webster Fig. 1 and Fig. 3, corresponding to Fig. 1 and Fig. 3 of Webster's patent of Great Britain, No. 1955, of 1857. They are given in tables V and VI.

The dimensions of this exhibit, as to its essential parts, are as follows:

Diameter of steamway	1.184 in.
Diameter of upper edge of valve seat at bevelled ground joint	1.480 "
Diameter of rim surrounding valve seat at its upper edge, inside	2.41 "
Diameter of rim surrounding valve seat at its upper edge, outside	2.48 "
Thickness of this rim at its upper edge	.035 "
Height of rim, inside, above plane of extended valve seat	.50 "
Diameter of lip around adjustable flange, Fig. 1, inside	2.532 "
Width of space between the inside of this lip (Fig. 1) and the outside of rim surrounding valve seat—that is, width of stricture of Fig. 1	.026 "
304 Width of lip, measured vertically, inside	.10 "
Bevel of valve seat at ground joint from the vertical	Deg., 39
Vertical height of bevelled valve seat	.181 in.
Horizontal width of bevelled valve seat	.146 "
Width of valve seat on the bevel	.232 "

Diameter of compensation flange, Fig. 3, outside of lip-- 2.38 "
Width of space between the outside of this flange and lip and the inside of rim surrounding valve seat—that is, width of stricture, Fig. 3 ---------- .015 "

These flanges are both adjustable up and down, and have been provided by complainants with screw-threaded valve stems and flange hubs for the purpose of adjustment.

Experiments with Complainants' Exhibit Webster Fig. 3, beginning with the lower edge of lip of flange just level with the upper edge of rim surrounding valve seat; overlap = 0.000; overlap then adjusted as shown in column 2, headed "Overlap."

TABLE V.

Webster Fig. 3.

No. of experiment.	Overlap, inches.	Warn, lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	REDUCTION. Lbs. per *per* sq. in.	REDUCTION. Per cent.	Per cent., mean.
1	2	3	4	5	6	7	8
71	0.0	95.25	99	95.25	3.75	3.8	3.8
72	.0035	94.5	98	94.25	3.75	3.8	
73	.0069		99.5	87.5	12	12.1	12.3
74	.0069		100	87.5	12.5	12.5	
75	.0104		99.5	85	14.5	14.5	14.4
76	.0104	92.5	100	85.5	14.5	14.5	
77	.0139	92.5	100	81.75	18.25	18.25	18.4
78	.0139	92.75	99.5	82	17.5	17.57	
79	.0174	92.5	100	79	21	21	20.7
80	.0174	92	99.5	79.25	20.25	20.35	
81	.0243	92.5	100.5	72.5	28	27.9	27.9
82	.0278	92.5	100	71.5	28.5	28.5	28.5
83	.0300	92.5	100	68	32	32	32

Experiments with Complainants' Exhibit Webster Fig. 1, beginning with the lower edge of lip of flange just level with the upper edge of rim surrounding valve seat; overlap = 0.0; overlap adjusted as shown in column 2, headed "Overlap."

305 TABLE VI.

Webster Fig. 1.

No. of experiment.	Overlap, inches.	Warn, lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	REDUCTION. Lbs. per sq. in.	REDUCTION. Per cent. Single.	REDUCTION. Per cent. Mean.
1	2	3	4	5	6	7	8
84	0.0		100	94	6	6	6.0
85	0.0		100	94	6	6	
86	.0035	94	100.25	92.25	8	8	7.3
87	.0035	92.25	99	92.5	6.5	6.6	
88	.0069	92.5	99.5	92	7.5	7.5	7.5
89	.0069	92.5	99.5	92	7.5	7.5	
90	.0104		99.5	91	8.5	8.5	9.0
91	.0104	92	100	90.5	9.5	9.5	
92	.0139	92	99.5	89.5	10	10.1	10.3
93	.0139	91	100	89.5	10.5	10.5	
94	.0174	91	100.25	88	12.25	12.2	12.3
95	.0174	91.5	100.5	88	12.5	12.4	
96	.0208	90	99.5	85.5	14	14.1	14.1
97	.0208	90.5	99.5	88.5	14	14.1	
98	.0243		100	84	16	16	16
99	.0243	90	100.5	84	16.5	15.9	
100	.0278		100.5	83	17.5	17.4	17.6
101	.0278	90.25	100.25	82.5	17.75	17.7	
102	.0313	91	100.5	80.5	20	19.9	19.9
103	.0313	91	100.5	80.5	20	19.9	
104	.0382	90	100	76.5	23.5	23.5	23.8
105	.0382	90	100	76	24	24	
106	.0451	90	100	71	29	29	28.9
107	.0451	90	100.5	71.5	29	28.8	
108	.0521	90	100.5	66.5	34	33.8	33.6
109	.0521	90	100	66.5	33.5	33.5	
110	.0555	90	100.75	64.5	36.25	36	35.9
111	.0555	90	99	63.5	35.5	35.8	
112	.0694	89.5	99	56	43	43.4	43.4
113	.0694	91	100	56.5	43.5	43.5	

With equal overlap, the operation of this Webster safty-valve, complainants' exhibit, agrees very closely with that of Richardson's patent. The action is every way as good. The adjustable overlap gives perfect control of the operation.

Adjusted as in experiments 71, 72, or as in experiments 84 to 89, this exhibit, just as it is, lever and all, is an admirable safety-valve, fit to be used on any stationary boiler of suitable size, at eighty to one hundred pounds pressure.

(The above answer objected to because incomplete for comparison with former experiments with other valves, as no description or value or stress of spring is given.)

306 Int. 6. Please examine Defendants' Exhibits Webster Valves, Figs. 1 and 3, and state whether or not you understand them; if so, please give their dimensions and the result of any trials which you may have made with them.

Ans. I understand said exhibit. On the 19th and 20th of January, 1886, I experimented with safety-valves made by the Crosby Steam Gage & Valve Company according to dimensions and drawings obtained from the drawings accompanying letters patent of Great Britain No. 1955, of 1857, granted to James Webster, by Mr. William H. Harrison and by me. I have compared these two sets of measurements and find them to agree.

The important dimensions are as follows:

(1.) Diameter of steamway ..... 1.22 in.
(2.) Diameter of lip of flange:
Fig. 1, inside of lip ..... 2.54 in.
Fig. 3, outside of lip ..... 2.36 in.
(3.) Diameter of wall of chamber:
Fig. 1, outside of wall ..... 2.49 in.
Fig. 3, inside of wall ..... 2.41 in.
(4.) Horizontal width of stricture:
$(2.54 - 2.49 = 2.41 - 2.36) \div 2$ ..... .025 in.
(5.) Position of flange, adjustable.

Trial of Webster Valve, Fig. 1.

Length of spring compressed to pop at one hundred pounds.. 2.32 in.
Compression to pop at one hundred pounds ..... .18 in.

The result of the test is found in table VII.

TABLE VII.

No. of experiment.	Position of lip of flange.	Warn, lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	REDUCTION. Lbs. per sq. in.	REDUCTION. Per cent. Single.	REDUCTION. Per cent. Mean.
1	2	3	4	5	6	7	8
	Clearance.						
245	.015		100.5	96	4.5	4.5	
246	"	96	100.5	96	4.5	4.5	4.5
247	"	96	100.5	96	4.5	4.5	
248	.010		100.5	95.5	5	5	
249	"	95.5	100.5	95.5	5	5	5.0
250	"	95.5	100	95	5	5	
307							
251	.005		100.5	93.5	7	7	
252	"	96	100.5	93.5	7	7	
253	"	96	100.5	93.5	7	7	7.0
254	"	96	100.5	93.5	7	7	
255	.000	97	100	93.5	6.5	6.5	
256	"	97	100	93.5	6.5	6.5	6.5
257	"	97	100	93.5	6.5	6.5	
	Overlap.						
258	.005	97	100	91	9	9	
259	"	97	100	91	9	9	9.0
260	"	97	101	92	9	9	
261	.010	97	101	88	13	12.9	
262	"	97	100.5	88	12.5	12.4	12.6
263	"	97	100.5	88	12.5	12.4	
264	.015	98	100.5	85.5	15	14.9	
265	"	98	100.5	85.5	15	14.9	14.9
266	.020	98	100	80	20	20	
267	"	98	100	80	20	20	20.0
268	.025	98	100	78	22	21.8	
269	"	98	100.5	78.5	22	21.8	21.8

Trial of Webster Valve, Fig. 3.

Spring of No. 5 wire gauge, length, free ..... 2.50 in.
Length compressed to pop at 100 lbs. ..... 2.32 in.
Compression for 100 lbs. = ... 0.18 in.

The result of the test is found in—

TABLE VIII.

No. of experiment.	Position of lip of flange.	Warn, lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	REDUCTION. Lbs. per sq. in.	Per cent. Single.	Per cent. Mean.
1	2	3	4	5	6	7	8
	Clearance.						
270	.015	Rarely	100	98	2	2	
271	"	any	100	98	2	2	
272	"	warning;	100	98	2	2	
273	"	sometimes	100	98	2	2	2.0
274	"	just	100	98	2	2	
275	"	distin-	100	98	2	2	
276	"	guishable.	100	98	2	2	
277	.010	99	100	97	3	3	
278	"	99	100	97	3	3	3.0
279	"	99	100	97	3	3	
280	"	99	100	97	3	3	
281	.005	99	100	96.5	3.5	3.5	
282	"	99.5	100.5	97	3.5	3.5	
283	"	100	100.5	97	3.5	3.5	3.5
284	"	100	100.5	97	3.5	3.5	
285	"	100	100.5	97	3.5	3.5	
308							
286	.000	99.5	100	93	7	7	
287	"	99.5	100	93	7	7	7
288	"	99.5	100	93	7	7	
	Overlap.						
289	.005	99.75	100	90.5	9.5	9.5	
290	"	99	99	90	9	9.1	9.3
291	"	99	99.5	90.5	9	9	
292	.010	97.5	98.5	83	15.5	15.7	
293	"	97.5	98.5	83	15.5	15.7	15.7
294	"	97	98.5	83	15.5	15.7	
295	.015	99	100.5	84	16.5	16.4	16.6
296	"	98.5	101	84	17	16.8	
297	.020	99	100	75	25	25	25
298	"	98	100	75	25	25	
299	.025	98	100	70.5	29.5	29.5	29.5
300	"	98	100	70.5	29.5	29.5	

The seven experiments, Nos. 270 to 276, are quite remarkable. The pop was clear, full, and distinct, generally without distinguishable warning; the closure prompt, full, and tight; the reduction 2 lbs. = 2 per cent., and the pressure was kept uniformly between the limits of one hundred pounds popping pressure and ninety-eight pounds closing pressure. The action was in all respects admirable. The subsequent experiments, Nos. 277 to 288, are all at practically useful degrees of reduction, 3, 3.5, and 7 per cent., and Nos. 289, 290, 291, 9 per cent., is, for good boilers, in my judgment, as good as any of the preceding.

The whole series of experiments is remarkably regular and consistent; each one confirms the accuracy of all the rest.

Int. 7. Please examine Defendants' Exhibit New Crosby Valve without Ring and give its dimensions and the result of any tests made by you; also please examine Defendants' Exhibit Old Crosby Valve with Ring and give any tests made with it.

Ans. The dimensions of the first-mentioned exhibit are as follows:

Dimensions.

(1.) Diameter of outer circle of steamway, inches, 2.50.
(2.) Diameter of inner circle of steamway, inches, 1.06.
(3.) Diameter of each of the four orifices leading outwards from central cell, inches, 0.20.

On Sept. 3 and 4, 1885, I made experiments with the above-mentioned exhibits. They are as follows:

309 Sept. 3, 1885.—Experiments with various popping pressures, 120 to 150 pounds, and with various corresponding degrees of compression of spring; no other change; defendants' new Crosby valve without ring.

TABLE IX.

No.	Warn.	Pop.	Close.	REDUCTION. Lbs.	Per cent.	Remarks.
224	119.5	120	117.5	2.5	2.1	
225	124.5	125	122.5	2.5	2	
226	129.5	130	127.5	2.5	1.9	3 times.
227	134.5	135	132.5	2.5	1.8	3 times.
228	139.5	140	137	3	2.1	twice.
229	144	145	142	3	2.1	
230	149	150	147	3	2	
	Mean reduction			2.7	2.0	

Old Crosby safety-valve, with adjustable ring; ring adjusted at each readjustment of popping pressure, made by altering the compression of spring.

TABLE X.

No.	Warn.	Pop.	Close.	REDUCTION. Lbs.	Per cent.	Remarks.
231	149	150	147	3	2	twice.
232	144	145	142	3	2.1	twice.
233	139	140	137	3	2.1	3 times.
234	134	135	132.5	2.5	1.9	3 times.
235	129	130	127	3	2.3	3 times.
236	124	125	121.5	3.5	2.8	4 times.
237	119	120	117	3	2.5	3 times.
	Mean reduction			3	2.2	

Old Crosby safety-valve, with adjustable ring, set (by altering compression of spring) to pop at various pressures, from 120 to 150 pounds, the ring remaining in one position in all these cases.

SEPT. 4, 1885.

TABLE XI.

No.	Warn.	Pop.	Close.	REDUCTION. Lbs.	Per cent.	Remarks.
238	119.5	120	117.5	2.5	2.1	twice.
239	124.5	125	121.5	3.5	2.8	twice.
240	129.5	130	126	4	3.1	twice.
241	134.5	135	131.5	3.5	2.6	3 times.
242	139.5	140	135.5	4.5	3.2	twice.
243	144.5	145	140.5	4.5	3.1	twice.
244	149.5	150	144.5	5.5	3.7	twice.
Mean reduction				4	2.9	

310 *Testimony of George W. Richardson.*

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Dec.* 28, 1886.

Int. 1. Please state name, residence, and occupation.

Ans. George W. Richardson; Bridgeport, Conn.; superintendent of Consolidated Safety Valve Company.

Int. 2. Are you the person of the same name given in letters patent of George W. Richardson, filed in this cause?

Ans. I am.

Int. 3. How long have you been employed as superintendent by the Consolidated Safety Valve Company?

Ans. I think it is seven years; ever since its organization.

Int. 4. During this time have you had under your direction the construction of the safety-valves made by the Consolidated Safety Valve Company?

Ans. Not directly the construction, but my business has been mostly designing valves and tools.

Int. 5. Are you familiar with the construction and the design of the safety-valves made by said company during the time of your superintendency?

Ans. I think I am.

Int. 6. The Consolidated Safety Valve Company mentioned by you is the complainant in this case, is it not?

Ans. I believe it is.

Int. 7. Please examine the valves now shown you and state whether or not they were constructed by the complainant company.

Ans. I think they were. They have our mark or tag on them.

(Valves shown witness are put in evidence and marked as follows:

(1.) Defendants' Exhibit Richardson Valves, ¾ in., No. 102, J. G. S., master. This is the valve marked for identification Oct. 19, 1886.

(2.) Defendants' Exhibit Complainants' Valve, 1 in., No. 4692, J. G. S., master.

(3.) Defendants' Exhibit Complainants' Valve, 1¼ in., No. 889, J. G. S., master.

311 (4.) Defendants' Exhibit Complainants' Valve, 1½ in., No. 487, J. G. S., master.

(5.) Defendants' Exhibit Complainants' Valve, 2 in., No. 123, J. G. S., master.

(6.) Defendants' Exhibit Complainants' Valve, 2½ in., No. 148, J. G. S., master.

(7.) Defendants' Exhibit Complainants' Valve, 3 in., No. 188, J. G. S., master.

(8.) Defendants' Exhibit Complainants' Valve, 3½ in., No. 123, J. G. S., master.

(9.) Defendants' Exhibit Complainants' Valve, 4 in., No. 130, J. G. S., master.)

Int. 8. Please examine Defendants' Exhibits Complainants' Valves, ¾ in., 1 in., 1¼ in., 1½ in., 2 in., 2½ in., 3 in., 3½ in., 4 in., and also Defendants' Exhibit 14, Richardson Valve, and Complainants' Exhibit C (the last two mentioned in the record in this case), and state whether or not they differ from safety-valves of corresponding size made and sold by the complainants during the time from the origin of the company to Jan. 31, 1885.

Ans. They do differ materially from valves made at the origin of the company. There are improvements, in different parts of the valve and case combined, from valves made at that time.

Int. 9. Please examine Defendants' Exhibit Complainants' Valve, 4 in., and point out any difference in that valve from 4-in. valves made by the complainant company during the period named, excluding in your answer the shell or case, the lever, spring, pintle, and other accessories which may hold to or remove the valve from its seat.

Ans. There is a little difference in the form of the annular chamber from the valves made at the time spoken of, but the principle and action of the valves are very nearly the same.

Int. 10. Please describe that difference of form of the annular chamber.

Ans. The annular chamber in the valve proper is more nearly square in the top than in the ones made at the time referred to. It also has intermediate wings or braces.

Int. 11. The words in your answer to Int. 9, "very nearly," am I to understand to mean substantially?

312 Ans. I mean that I like this valve better than the other; if I didn't, I shouldn't make them this way.

Int. 12. Please define what you mean by "very nearly."

Ans. I mean that each one of them has an annular chamber of very nearly the same size, all the difference being in form. The action is very nearly alike; I like the action of this better than the other, somewhat.

Int. 13. Please consider the complainants' valves, 3½ in., 3 in., 2½ in., and 2 in., in the same way as you have just considered the 4 in. under Int. 9.

Ans. Without taking the valves apart, I should answer the same.

Int. 14. Do you wish them taken apart?

Ans. Not unless you do.

Int. 15. The valves having been taken apart, please to answer Int. 13.

Ans. All of the exhibits except the 2 in., No. 128, have the difference spoken of with regard to the 4-in. valve. The 2-in. valve has the annular chamber and adjustable ring of the same style as we made, as near as I can recollect, but I may forget some parts of it.

Int. 16. That difference mentioned is in the form of the annular chamber which you have given, is it?

Ans. It is.

Int. 17. Please examine Defendants' Exhibit 14 and Complainants' Exhibit C, and in considering them exclude all but the valve body or bush and the valve proper. Then please state whether or not they differ from 2½-in. valves or locomotive valves made and sold by the complainants from Feb. 15, 1879, to Jan. 31, 1885.

Ans. I think they are virtually the same.

Int. 18. Please examine complainants' valves, ¾ in., 1 in., 1¼ in., and 1½ in., excluding the cases, lever arrangements, and lock-up attachments, and state in what respects, if any, they differ from valves of corresponding sizes made and sold by complainants during the period named in the last question.

Ans. I think they embody the same general features as the valves referred to in the last question.

Int. 19. Between the said ¾-in. valve and the 4-in. valve
313 which have been testified of, were there any sizes of valves during the period named, other than the sizes already given, made and sold by the complainants?

Ans. I don't remember any.

Int. 20. During that period were there not valves larger than 4 in. made and sold by complainants?

Ans. There were, I think, 4½, 5, 5½, and 6 in.

Int. 21. Were these valves made substantially, as to the valve body or bush and the valve proper, like Defendants' Exhibit Complainants' Valve 4 in., except as to size?

Ans. Not all of them. I think we made some special valves with slight differences, which I can't just recollect now; but, as I understand it, most of them were.

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 22. Do the valves which have been produced, ranging from ¾ in. to 4 in., include all the styles or classes of safety-valves embodying substantially the construction of valve body and valve proper here represented in the valves produced, which you made during the period from the formation of the Consolidated Valve Company to Jan. 31, 1885; and, if not, what other classes than those produced were so made by said company?

Ans. I think they include all.

Cross-int. 23. Then you made no other sizes of brass-cased valves

and no other styles of brass-cased valves than the four sizes and style here before you, ranging from ¾ in. to 1½ in., did you?

Ans. We did. We made 2 in., 2¼ in., 2½ in., and 3 in., and perhaps other sizes, which I do not remember. I didn't understand the question before to include exact sizes. We also made other styles of brass-cased valves.

Cross-int. 24. Did you make any smaller sizes of iron-cased valves than 2 in.?

Ans. We did; as small as down to ¾ in., 1½, 1¼, 1, and ¾ in., I think.

Cross-int. 25. And did you make any other styles of iron case for any of these sizes of iron valves from ¾ in. to 6 in. than the iron case with a side outlet?

314 Ans. I think we did make some cases with a top plain outlet and some with a top screwed outlet to attach a pipe to.

Cross-int. 26. Did you make any other shape of iron case than the one here produced?

Ans. We did.

Cross-int. 27. Did you make any other sizes of unencased valves than 2¼ in.?

Ans. I think we might have made some on special orders; I feel very sure we did.

Cross-int. 28. You have said that you liked the action of the valve with the angular annular chamber better than the action with the other chamber, somewhat. What is there in the action of the two valves which makes you like that of the one more than the other?

Ans. In testing the valves with steam I think they test a little easier; or, in other words, I can test more of them in a given time.

Cross-int. 29. In these other sizes and styles of brass valves you have spoken of, has there been any substantial difference in the construction of the valve proper, of the bush, and of the adjustable ring, from what is shown in the brass valves now before you?

Ans. We did make some valves, when I first went to work for the company, with a top outlet and a lever, where the valve was constructed like the valve on page 14 of complainants' catalogue of 1879.

Cross-int. 30. Other than the valves like the picture on page 14, were your brass valves arranged with valves proper, bushes, and adjustable rings, in substantial likeness to those of the brass valves before you, namely, ¾, 1, 1¼, and 1½ in.?

Ans. As I understand it, they were.

Cross-int. 31. Now, as to the other iron-cased valves which you made of smaller and larger sizes than the iron-cased valves from 2 to 4 in., inclusive, before you, were they arranged with bushes, valves proper, and adjustable rings, substantially similar to those of these iron valves from 2 in. to 4 in., inclusive?

Ans. When I first went to work for the company I made some valves like that pictured on page 7 of complainants' catalogue of 1879, arranged with an adjustable ring; but just as fast as I could change the pattern I made them substantially like those before me.

315 *Testimony of William H. Harrison.*

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Dec.* 29, 1886.

Int. 1. Please state your name, age, residence, and occupation.

Ans. William H. Harrison; forty-six; Braintree, Mass.; mechanical engineer.

(Defendants offer in evidence a certified copy of letters patent of the United States, granted to George W. Richardson Sept. 25, 1886, No. 58294, for improvement in steam safety-valves, and same is marked "Richardson 1866 Patent, J. G. S., master;" also certified copy of the original drawings filed in the matter of said letters patent, and the same is marked "Richardson 1866 Drawing, J. G. S., master.")

Int. 2. What has been your experience in mechanical matters, especially those relating to machinery operated by steam, and their appliances?

Ans. I went into the machine shop when I was sixteen and one-half years old, and worked on steam machinery in Hinsdale, N. H. and with the Putnam Machine Company, in Fitchburg, Mass. In July, 1861, I passed the examination required for candidates and was appointed an assistant engineer in the regular service in the United States Navy. I served altogether about eleven and one-half years as an assistant engineer of different grades. I had considerable sea service in different vessels, and was inspector of construction of hulls, engines, and boilers at Chelsea and in the United States navy yard in Charlestown, Mass.

During my sea service I served as chief engineer on all the vessels to which I was attached, save one.

During the last two years that I held my commission as first assistant engineer, United States Navy, I was off duty, and was employed as inspector of the steel and iron of the St. Louis bridge.

I have designed, constructed, and operated mill engines, blowing engines for blast furnaces, pumping engines, and marine engines, with their boilers and attachments.

A general knowledge of the operation of safety-valves is a part of the mental equipment of an engineer. We put them in any
316 place where there is liable to be damage caused by overpressure of fluids within their containing vessels.

Int. 3. Please state whether or not you understand Defendants' Exhibit Richardson Valve, like photo-lithograph drawing. If so, have you obtained the dimensions of its parts, as those of the valve proper and body, and how do these dimensions compare with the dimensions of the same exhibit as found in Ans. 1 of deposition of J. C. Hoadley herein?

Ans. I do understand the exhibit, and have obtained its dimensions. The dimensions are the same as those given in Mr. Hoadley's answer.

Int. 4. Please examine Exhibit Richardson 1866 Patent and state whether you have measured the parts of the safety-valve shown in Figs. 3 and 4 of the drawing therein; and, if so, how do these dimensions compare with the dimensions of the corresponding parts of the said valve just referred to.

Ans. I have examined the patent and have measured the photo-lithographic reduction, and find the dimensions the same as those of the valve exhibited.

Int. 5. Whether or not you have made any tests of said valves with direct springs under steam pressure; and, if so, please describe them.

(Objected to as incompetent and irrelevant on the issues in this accounting as distinguished from the issues already passed upon by the Supreme Court, and as inadmissible on the issues passed upon by the Supreme Court; and further objected to because defendants have themselves shown a variance between the photo-lithograph from which this valve purports to be made and the original drawing filed by Richardson, for which alone complainants are responsible.)

MASTER: Mr. Millett, please state the purpose for which you ask this question—that is, state its competency and relevancy to the issues before me, as you view it.

Mr. MILLETT: The purpose the defendants have in offering this testimony is to show that the safety-valve made exactly like the photo-lithograph drawing above mentioned, when subjected to use upon a steam-boiler, is not a prudent safety appliance, and as such has no commercial value, and that safety-valves made in ac-
317 cordance with the description and drawings in the Richardson patent have no market value as safety appliances; and the same applies to safety-valves made in accordance with the certified tracing produced of the original drawing; and for the further purpose of showing that the application by the defendants, in whatever way found by the court, in the making of their safety-valve, was of no advantage to them and no loss to the complainants; and for the further purpose of showing that the complainants themselves have never made safety-valves like those described in the said Richardson patent and drawing, and so have never suffered loss or damage by any act of the defendants in the making and sale of the Crosby valves; and for the further purpose of showing generally that no merchantable article could be manufactured by the use of the means patented by Richardson.

Mr. CLARKE: The objection is that the Supreme Court has decided that the Richardson patented invention is a prudent safety appliance and had a commercial value, and that it has been largely made and used, and defendants, having been found infringers, may be indeed permitted to prove the *quantum* of advantage to them and loss to complainants, but cannot be permitted to prove that their wrong did the defendants no injury whatever.

MASTER: The question may be put. I will endeavor to deal with the evidence which may be given in response thereto in my draft

and final reports in such manner as to save the rights of the parties hereto.

Ans. I have made steam trials with this valve with direct springs. On Monday, Nov. 16, 1885, I took the dimensions of this valve, which agree with similar dimensions taken by Mr. Hoadley, and I now put in one additional, namely, diameter at top of ground joint, 1.65 in.

First. In my first experiment of this series I used the spring marked "80 to 100 lbs." It is composed of 8½ turns of steel, .21 in. square section. The length when open is 2.85 in., compressed for 100 lbs. pressure is 2.35 in., and the amount of compression is .50 in. This valve warned at 99 lbs., boiler pressure; popped at 100 lbs.; closed at 71 lbs., a reduction of 29 lbs. This was four times repeated after the final spring adjustment was made. The lift of the valve was .055 in.

Adjourned.

318 DEC. 30, 1886.

Second. On Monday, Nov. 17, 1885, I made an experiment, using the same Richardson valve, but with a heavier spring, marked "100 to 125 lbs." This spring is made of steel, .23 in. square. The diameter outside is 1.32 in. There are 8½ turns. The length of the spring before compression is 3.10 in. When compressed for working pressure its length is 2.75 in. The compression then is .35 in. In this trial the valve popped at 101 lbs. and closed at 72 lbs., a reduction of 29 lbs. of the boiler pressure. The lift of the valve was .055 in.

Third. On Saturday, Oct. 23, 1886, I tried the same Richardson valve, using a spring marked "125 to 140 lbs.," which is here exhibited. It is composed of 7¼ turns of steel .23 in. square. The outside diameter of spring is 1.40 in.; the length before compression, 3.05 in.; length compressed to 100 lbs. working pressure, 2.88 in. The compression then is .20 in. The experiment gave a result, three times repeated, of warned at 97 lbs., popped at 100 lbs., and closed at 75½ lbs. The reduction of boiler pressure was 24½ lbs. per square inch. The lift of the valve was .05 in.

Int. 6. Please state whether or not you have made any trials with the same valve rigged up with a lever and springs; if so, please produce the lever and springs used, to be put in evidence, and describe them, and thereupon describe the trials which you made.

Ans. I produce the lever spoken of and the other attachments used therewith.

(Lever and attachments produced are marked "Defendants' Exhibit Lever and Attachments (Harrison) Richardson Photo. L. Valve, J. G. S., master.")

I produce also the springs used in those tests.

(Springs produced are marked "Defendants' Exhibit Lever Spring, No. 11 Wire, 80 to 100 lbs., Richardson Photo. L. Valve, J. G. S., master;" "Defendants' Exhibit Lever Spring, No. 10 Wire, 100 to 120 lbs., Richardson Photo. L. Valve, J. G. S., master," and "De-

fendants' Exhibit Lever Spring, No. 9 Wire, 120 to 140 lbs, Richardson Photo. L. Valve, J. G. S., master.")

The length of the lever from fulcrum to centre of hook is 14 in.; from fulcrum to vertical axis of valve is 1.75 in. The lever
319 ratio then is 8 to 1. As used, the first spring was made of No. 11 steel wire, tempered, wound on a $\frac{7}{8}$-in. mandrel; number of turns of wire, 32; length of body of spring when not strained, 3.70 in.; the outside diameter of the spring, 1.02 in.; and being Defendants' Exhibit Lever Spring, No. 11 Wire, etc. The second spring used was made of No. 10 steel wire, tempered, wound on a $\frac{7}{8}$-in. mandrel; number of turns of wire, 30; length of body of spring when not strained, 4.10 in.; the outside diameter of the spring, 1.07 in.; and being Defendants' Exhibit Lever Spring, No. 10 Wire, etc. The third spring used was made of No. 9 steel wire, tempered, wound on a $\frac{7}{8}$-in. mandrel; number of turns of wire, 26; length of body of spring when not strained, 4 in.; the outside diameter of the spring, 1.12 in.; and being Defendants' Exhibit Lever Spring, No. 9 Wire, etc. The trials which I made are as follows:

Mr. Harrison's Experiments with Richardson 1886 Photo-Lith. Lever and Spring.

Size of spring used.	INCHES. Overlap constant.	Extension of spring.	Lift of valve.	Warn.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Pop.	Close.	Reduction.
No. 11 wire	.025	2.00	.055	97	100	69	31
" " "	"	"	"	97	100	69	31
" " "	"	1.71	.055	78	80	56	24
" 10 "	"	1.40	.05	98	100	72½	27½
" " "	"	1.70	.05	118	120	86	34
" 9 "	"	.70	.043	98	100½	79½	21
" " "	"	.85	.043	119	120	93½	26½
" " "	"	1.00	.043	139	140½	104½	36

Int. 7. Please state whether or not you have made measurements of the valve shown in the certified copy of the original drawing of the Richardson 1866 patent; also measurements of corresponding parts of the safety-valve marked "Defendants' Exhibit Richardson Valve from Original Drawing;" if so, please state how they compare with each other, and also how they compare with the dimensions given in the deposition of J. C. Hoadley herein in answer to Int. 3.

Ans. I have measured the patent drawing, and I have measured the valve exhibited, and I find all the important dimensions the same. My dimensions are the same as Mr. Hoadley's. There was one dimension which he omitted, namely, the diameter at the top of the ground joint, which is 2.73 inches.

320 Int. 8. Whether or not you made any trials of the safety-valve mentioned in the preceding question; if so, please describe them, stating what spring or springs you used at such trials.

Ans. Two springs were used, the same Mr. Hoadley mentions, one of No. 6 and one of No. 7 wire. The No. 7 steel-wire spring was wound on a 1-inch diameter mandrel; number of turns, 30. The length of this spring when closed after test, and without strain upon

it, was 7 in.; when extended for 100 lbs. working pressure, the length was $9\frac{9}{16}$ in.; the extension under strain then was $2\frac{9}{16}$ in. The other spring was made of No. 6 steel wire, tempered, wound on a mandrel $1\frac{1}{8}$ in. diameter. The length of this spring before straining was $6\frac{3}{16}$ in.; when strained for 100 lbs. working pressure, $8\frac{1}{8}$ in.; extension under strain, $1\frac{5}{16}$ in.; number of turns, 24.

On Monday and Tuesday, Dec. 21 and 22, 1885, in company with Mr. John C. Hoadley, I made the following experiments with this valve, using these springs described, with the following results as tabulated:

		STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Size of spring.	Inches lift.	Warn.	Pop.	Close.	Reduction.
No. 7	.059	97	100	68	32
"	"	97	100	68	32
"	"	95	100	68	32
No. 6	.0555	97	100.5	71	29.5
"	"	97	99	70	29
"	"	96	100	71	29

Int. 9. Were you present with Mr. Hoadley when the trials were made by him of the complainants' Webster valve exhibits in this case; and, if so, did you take notes of those trials, and how do those notes compare with the statements made by Mr. Hoadley of those trials, as found in his answer to Int. 5?

Ans. I was present, and took notes. My figures are the same as those of Mr. Hoadley.

Int 10. Were you present at the trials made of Defendants' Exhibits Webster Valves, Figs. 1 and 3, mentioned by Mr. Hoadley in his answer to Int. 6; and, if so, did you take notes of those trials, and how do they compare with the statements made by him of them?

Ans. I was present at those trials, and took full notes.

Mr. CLARKE: I desire to object to any evidence with regard
321 to the new so-called Webster valve, Fig. 3, and Webster valve, Fig. 1, because the Supreme Court have decided that they did not anticipate, control, or affect the Richardson patent, and because they were never in their day and before the date of that patent or of Richardson's invention known or recognized as producing any such result as the apparatus of that patent produces, and because they have decided on the evidence in the principal case that such valves are practically and economically worthless, which decision of the court is not subject to revision before the master.

MASTER: The question may be answered. I reserve consideration as to the relevancy and competency of the evidence adduced by this and other questions upon the same subject to my draft and final reports. It is understood that the rights of all parties are reserved.

(Witness continues:) My figures relating to the experiments are the same, and show the same results.

Int. 11. Please examine the direct-acting spring connected with

Defendants' Exhibit Webster Valve, Fig. 3, and state whether that is the spring referred to by Mr. Hoadley as used in making the trials; and, if so, describe it.

Ans. It is the same spring described by Mr. Hoadley, and I find his description of it correct. That spring was used in the experiments on both valves.

Int. 12. Whether or not you obtained the dimensions of the several parts of the Webster valve, Figs. 1 and 3, referred to, as shown in the drawings of the James Webster patent given in the record in this case. If so, please to compare them with the dimensions of the corresponding parts of the Webster valve exhibits, Figs. 1 and 3, and also compare them with the dimensions given by Mr. Hoadley in his answer to Int. 6.

Ans. I have obtained those dimensions—that is, the dimensions from the Webster patent drawing—and I find them to agree with the dimensions of the valves exhibited. I find that Mr. Hoadley's dimensions agree with mine in every particular, except that in his description of Webster Fig. 3 he gives diameter of outside of lip of Fig. 3, 2.36 inches, the correct diameter being 2.37 inches; and Mr. Hoadley gives for the same valve, Fig. 3, the diameter of
322 inside of wall 2.41, and it should be 2.42, leaving the horizontal width of structure .025, as before. This would make no difference in the action of the valve. I should add that two additional dimensions are useful, which I will give, namely:

For Fig. 1, diameter at top of ground joint, 1.48 in.

For Fig. 3, same, 1.48 in.

Int. 13. Please state whether or not you have made tests of the said Defendants' Exhibits Webster Valve, Figs. 1 and 3, using a lever and spring or scales for holding the valve to its seat; if so, please describe said lever and spring and produce the same, and also give the results of your trials.

Ans. I have made such tests, and now produce the apparatus referred to.

(The levers produced are marked (1) "Lever for Webster, Fig. 1, J. G. S., master;" (2) "Lever for Webster, Fig. 3, J. G. S., master.")

The spring used is Defendants' Exhibit Lever Spring, No. 10 wire, etc.

The length of the levers from fulcrum to centre of hook is 16 inches in each case; length from fulcrum to vertical axis of valve is 2 inches in each case; the lever ratio, then, is 8 to 1.

I will give first the experiments with Webster valve, Fig. 1, fitted with a lever and the spring described, which are as follows:

Mr. Harrison's Experiments with Webster Valve, Fig. 1.

Remarks.	Overlap. Inches.	Extension of spring. Inches.	Lift of valve. Inches.	STEAM PRESSURE IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Clearance,	.01	1.00	.046	98	100	98	2
"	"	"	"	98	100	98	2
"	"	"	"	98	100	98	2
Clearance,	.005	1.00	.054	96½	100	96½	3½
"	"	"	"	96½	100	96½	3½
Flush,	00	1.00	.058	96	100	96	4
"	"	"	"	96	100	96	4
"	"	"	"	96	100	96	4
Overlap,	.005	1.05	.06	95½	100½	95½	5
"	"	"	"	95½	100½	95½	5
"	"	"	"	95½	100½	95½	5
Overlap,	.010	1.10	.064	94	100	92	8
"	"	"	"	94	100	92	8
"	"	"	"	94	100	92	8
Overlap,	.015	1.10	.075	94½	100	88	12
"	"	"	"	94½	100	88	12
Overlap,	.025	1.15	.078	96	10	82½	17½
"	"	"	"	96	1000	82½	17½
Overlap,	.04	1.15	.103	96	100	69	31

323 With Defendants' Exhibit Webster Valve, Fig. 3, fitted with its lever and the same spring described for the valve Fig. 1, I made the experiments, the results of which will be seen in the following table:

Mr. Harrison's Experiments with Webster Valve, Fig. 3.

Remarks.	Immersion of flange. Inches.	Extension of spring. Inches.	Lift of valve. Inches.	STEAM PRESSURE IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Clearance, =	.005	.95	.04	98	100	97	3
"	"	"	"	98	100	97	3
Flush, =	.00	.95	.041	97	100	93	7
"	"	"	"	97	100	93	7
Immersion, =	.005	.95	.044	97	100	89	11
"	"	"	"	97	100	89	11
Immersion, =	.01	.95	.05	97	100	83½	16½
"	"	"	"	97	99½	83	16½
Immersion, =	.025	.95	.077	97	100	72	28

Int. 14. Please define the words noted in the margin of the tables given, "clearance," "flush," "immersion," and "overlap."

Ans. "Clearance" means the vertical distance that the lower edge of the lip is above the wall.

"Flush" applies to the location in height of the lower edge of the lip, and means that said lower edge is level with the upper edge of wall.

"Overlap" means the distance that the lower edge of the lip is below the top of the wall. This expression occurs in the table referring to Fig. 1.

"Immersion" means the vertical distance that the lower edge of the lip of the compensating flange is below the upper edge of the wall. This expression occurs in the table referring to Fig. 3.

Int. 15. In Webster's patent is the following:

"The short case or hollow cylinder *g* may be dispensed with, and the sliding collar or flange *e* may be dropped down on the stem *c*, so as to rest on the top of the valve *a*."

Have you made a valve under that direction, and tested it? If so, produce it and describe it, and give its results under trial.

Ans. Such valve was made under my direction and tested by me, and I produce it.

324 (Valve produced is marked "Defendants' Exhibit Webster Valve, with flange resting on top of valve, J. G. S., master.")

This valve has the following dimensions:

Diameter of steamway	1.22	inches.
" " valve at top of ground joint	1.48	"
" " outside of valve seat	2.49	"
" inside the lip of overhanging flange	2.54	"
Width of the annular outlet	.025	"
Depth of lip below its flange	.10	"
Thickness of the head of the valve above its seat	.08	"
The overlap then is adjustable from nothing down to	.02	"

These dimensions I obtained from Fig. 1 of the patent drawing, and the directions for cutting down the wall of said valve from Webster's specification.

To the above-described valve a lever and suitable attachments for getting a strain on the spring are fitted.

The length of this lever from fulcrum to centre of hook is	16 inches.
The horizontal distance from the fulcrum to the vertical axis of the valve is	2 "

The lever ratio, therefore, is 8 to 1.

The spring used is the same No. 10 wire spring which has been described as used on the last two defendants' Webster exhibits.

The observed results of the experiments I have embodied in the following short table:

Mr. Harrison's Experiments with Webster Valve, Flange Resting on Top of Valve.

Remarks.	Overlap. Inches.	Extension of spring. Inches.	Lift of valve. Inches.	STEAM PRESSURE IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Greatest possible overlap, =	.02	1.10	.058	None	100	85	15
	.01	1.10	.045	95	100	92	8
	.005	1.10	.045	95	100	94	6

Int. 15½. Where was the flange at the overlap noted in the table at .02 inch?

Ans. It was resting on the top of the valve, and .02 inches was the greatest possible overlap for the lip of this valve.

325 Int. 16. The other positions noted in the margin designate what?

Ans. They designate the distance that the lip of the valve is below the outside upper edge of the valve seat.

Int. 17. What was the character and action of all these Webster valves described by you as tried at the trials?

Ans. The action was good. The valves opened well, good lift, relieved the boiler according to the amount of the overlap, and closed of their own accord.

(Defendants offer in evidence a tracing of the original drawing of a safety valve patented by H. Waterman Nov. 15, 1853, No. 10243, attached to the specification of said patent, and the same is marked "Defendants' Exhibit Waterman 1853 Patent and Drawing, J. G. S., master." Certification is waived. Objected to by complainants because the Waterman patent was introduced in evidence in the principal case, and no variance from what was considered by the court is now permissible. Ruling upon this offer is reserved to the draft report. Any evidence as to this exhibit will be received under the objections of complainants, to be passed on by the draft and final reports of the master. It is understood that all the rights of the parties are reserved.)

Int. 18. Have you read and do you understand the Waterman specification and drawing of his patent of 1853; if so, have you measured the parts of his safety valve and attachments and had constructed a safety valve like that shown? And, if so, give the measurements and produce it.

Ans. I have read said patent and have measured the drawing, and I understand them. I have had constructed under my supervision an apparatus which embodies the entire invention, to the dimensions shown in the drawing. I produce it.

(Apparatus produced is marked "Defendants' Exhibit Waterman 1853 Patent, J. G. S., master." The weight which is produced with the apparatus is of lead, and is stamped "9 lbs. 5½ oz.")

The measurements of the valve proper are—

Diameter of steamway	.86	inch.
" " outer edge of ground joint	1.04	"
" inside of chamber	1.20	"
" outside of flange	1.20	"
326 Depth of wall around the valve seat	.08	inch.
Radius of the curve of the under side of flange	.08	"

Form of the cross-section of the annular space under the outside edge of flange is quadrantal.

The dimensions of the lever are—

From fulcrum to vertical axis of weight	8	inches.
" " " " " " valve	1	"

Ratio of lever is 8 to 1.

Weight is of lead, 9 lbs. 5½ oz., equal to 9.344 lbs.

The dimensions of the dash-pot are—

Inside diameter	1.02 inches.
Diameter of the piston inside the dash-pot	.96 "
Clearance all round, between piston and bore of the dash-pot	.03 "

Int. 19. Whether or not you have made tests under steam of the said exhibit? And, if so, please give the results.

(Objected to because it appears from inspection that the weight produced is very much larger than the weight shown in the patent, and that there are other variations from the dimensions given in the patent; and, further, because no evidence which can be given to-day of what can be accomplished and what has been accomplished by this exhibit since the decision in this cause can be allowed to vary the evidence of Waterman himself as to what he accomplished prior to the date of the Richardson patent with the only valve that he ever made prior to that date, which accomplishment of Waterman, as testified by him in the principal case, is the only admissible evidence on this hearing to control in any way the construction or scope of the Richardson patent by the Waterman acts or deeds of any sort.

Master's ruling upon the admissibility of this evidence reserved to draft and final reports. It is understood that the rights of both parties are hereby reserved.)

Ans. I have made tests under steam of this exhibit. I find in Waterman's patent the following statement: "Into this cylinder I put a fluid—mercury, oil, alcohol, or water." In accordance with that statement, I filled the dash-pot with water and made my experiments. The valve opened at 99 lbs. pressure per square inch in the boiler, closed at 87 lbs., the reduction of boiler pressure
327 being 12 lbs. This was six times repeated and more. The lift of the valve was .04 in. The action was in every way perfect. The test being concluded, the dash-pot was opened, and the water was found to fill it up to the bottom of the screw of the cover.

Int. 20. Whether or not you made any trials with the same exhibit, the valve of which was held to its seat by a direct-acting spring? If so, please produce the spring, describe it, and give the results of your trial.

(Objected to on the ground that the last question has not been fully answered as to this exhibit. It has been answered only with regard to water in the dash-pot, and the master is requested to note that the smell of the dash-pot betrays the fact that sperm or lard oil has been used in it. On the matter of the smell referred to, the master will hear evidence if either party desires, the master preferring to avoid testifying in a cause before him, except in cases where it may be absolutely necessary.

Question further objected to because no description is given in the Waterman patent of the use of a direct-acting spring, and there

is no evidence in this case from which the instruction can be obtained as to the method of applying a direct-acting spring to a Waterman valve, which dates back to the time of the Waterman patent, namely, Nov. 15, 1853.

Master's ruling on this objection reserved to the draft and final reports, rights of both parties being reserved.)

Ans. I did. I produce the spring and the studs, spindle, yoke, and nuts, which are used with the spring.

(The apparatus produced is marked "Defendants' Exhibit Defendants' Direct Spring for Waterman Valve, J. G. S., master.")

This spring is made of tempered steel wire, gauge size No. 10; diameter of coil outside, .75 in.; number of turns in coil, 8; length of spring, open before compression, 2 in.; length when set for 100 lbs. working pressure, 1.60 in.; compression of spring when so set, .40 in. I tested this valve Sept. 14, 1886, and obtained from it the following results:

Popped without warning at 100 lbs. boiler pressure; closed at 92 lbs.; reduction of boiler pressure, 8 lbs. per square inch; lift of valve, .03 in. This was several times repeated.

(Adjourned.)

328 DEC. 31, 1886.

Int. 21. What was the action of this valve in the several tests made by you?

Ans. The action was in every way good. With the valve fitted with the lever, weight, and dash-pot, with the water therein, it went up with a smooth, even motion, until the motion of the lever was stopped by contact of the piston with the cover of the dash-pot. When the valve was fitted with the spring, it had a quicker action in opening and closing, and, so far as I could see, was exactly the same as many other pop valves. It opened to its full extent .03 in., and when it closed, it closed tightly.

Int. 22. For usefulness as a safety-valve, how did the two actions compare?

Ans. They were equally good.

Int. 23. What was the action and operation of the Richardson valves testified by you as experimented with, namely, the Richardson photo-lithograph valve and the valve from the original Richardson drawing?

Ans. The action was in every way good. I mean by that after the springs had been adjusted to the required popping pressure, that the pops occurred consecutively at each time that the boiler pressure reached the limit. The valves went up with a generous lift and relieved the boiler in each case about an equal amount, and closed tightly after the relief had been obtained, as appears from the tables.

Int. 24. Will you please make and produce as an exhibit in this proceeding a full-sized drawing of a cross-section of Defendants' Exhibit Webster Valve, with flange resting on top of valve?

Ans. I will.

Int. 25. Examine the following Defendants' Exhibits Richardson Valve ¾ in., No. 104; Complainants' Valves 1 in., No. 4692; 1¼ in., No. 889; 1½ in., No. 487; 2 in., No. 123; 2½ in., No. 148; 3 in., No. 188; 3½ in., No. 123; 4 in., No. 130, and Defendants' Exhibit 14 and Complainants' Exhibit C, and state whether or not you have obtained the dimensions of the valve body and valve proper of each
329 and of other parts which will disclose the openings and the peculiar features of these valves, and tested them.

Ans. I have examined them and taken the measurements and tested them.

Int. 26. What was the condition of all these valves just mentioned, except the ³ in. and Defendants' Exhibit 14 and Complainants' Exhibit C, when they came to your possession for trial, so far as their external appearance is concerned?

Ans. The apparent condition of all was that of new valves sent out from the shop ready for use. Lead seals were in their places on the heads of the brass valves, and the brass tag and wire which form a seal on the iron valves were also in their places and unbroken.

Int. 27. Was this condition changed when you made the tests of them?

Ans. It was not.

Int. 28. Will you describe in what way and how you tested them?

Ans. In the case of the brass valves, I drilled a hole in the top of the cap for the purpose of inserting a wire to determine the amount of the lift of the valve when in action. In the case of the iron valves, I made no change, but tested them as they stand here. After completing my recorded tests of their action, I removed the top and lever for the purpose of determining the amount of the lift of the valve when in action. The valves were connected to a large testing boiler at the Crosby Gage Company's works and the results of their action noted.

Int. 29. Were these valves, sealed as you have described, taken by you and placed on the boiler spoken of and allowed to operate without any manipulation whatever on your part?

Ans. Yes, sir.

Int. 30. Do all these exhibits, with the exception of Defendants' Exhibit 14 and Complainants' Exhibit C, have indicated upon them the pressures at which they were set to open and close? If so, please give what is stated in that regard on each.

Ans. On the ¾-in. brass valve there is stamped, "Set 100."
330 I understand that to mean that the valve is to open when the boiler pressure reaches 100 lbs. to a square inch.

The 1-in. valve is stamped, "Set 100."

The 1¼-in. valve is stamped, "Set 100."

The 1½-in. valve is stamped, "Set 100."

The 2-in valve is stamped on its brass tag, "Pops at 80, closes at 77." This I interpret to mean that the spring of this valve is so adjusted that the valve will open when the steam pressure in the boiler has reached 80 lbs., no more and no less, and also that the valve will close when the steam pressure in the boiler has decreased to 77 lbs., no more and no less.

The 2½-in. valve has stamped on its tag, "Pops at 80, closes at 77."
The 3-in. valve has stamped on its tag, "Pops at 80, closes at 76."
The 3½-in. valve has stamped on its tag, "Pops at 80, closes at 77."
The 4-in. valve has stamped on its tag, "Pops at 80, closes at 77."

Int. 31. When you made the trials of these valves, did you know as to the accuracy of the steam-gauge used to indicate the results?

Ans. I tested the gauge in comparison with the standard gauge of the Crosby Steam Gage and Valve Company and found it to be correct.

Int. 32. Please give the dimensions of Richardson valve, ¾ in., No. 104, and the result of the trial which you observed of it.

Ans. I give the following dimensions:

Diameter of steamway	.75	inch.
" at top of ground joint	.84	"
" at outside of upper edge of adjustable ring	1.08	"
" at inside edge of lip	1.11	"
Horizontal width of outlet at lip	.015	"

There is no overlap, as daylight is visible in a fine line under the lip.

The spring is composed of 8½ turns of steel, $\frac{3}{16}$ in. square. The outside diameter of the spring is 1.20 in.; its length when free, 2.60 in.; length when compressed to working pressure, 2.43 in.; compression at 100 pounds, .17 in.

With this valve and spring, on Saturday, Oct. 23, 1886, I made a test, the results of which are set forth in the accompanying table:

331 *Mr. Harrison's Test of Richardson Valve, ¾ Inch, No. 104.*

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.03	99	100	97	3
"	99	100	97	3
"	99	100	97	3
"	99	100	97	3

Int. 33. Give the dimensions of Defendants' Exhibits Complainants' Valves, 1 inch, No. 4692; 1¼ inch, No. 889; 1½ inch, No. 487; 2 inch, No. 123; 2½ inch, No. 148; 3 inch, No. 188; 3½ inch, No. 123; 4 inch, No. 130, and the result of the test of each.

Ans. (1.) 1-inch valve, No. 4692, dimensions are—

Diameter of steamway	1	inch.
" at top of ground joint	1.10	"
" at outside of upper edge of adjustable ring	1.37	"
" at inside edge of lip	1.44	"
Horizontal width of outlet at lip	.035	"
Overlap	.03	"

The spring is composed of 7½ turns of steel $\frac{3}{16}$ inch square; outside diameter of spring, 1.25 inches; length when free, 2.90 inches; length when compressed to working pressure, 2.69 inches; compression at 95 lbs., .21 inch.

Result of test, Monday, Oct. 4, 1886, is shown in the following table:

Mr. Harrison's Test of Complainants' Valve, 1 Inch, No. 4692.

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.03	No warning.	96	94.5	1.5
"		96	94.5	1.5
"		96	94.5	1.5
"		95	92.5	2.5
"		93.5	92	1.5
"		93.5	92	1.5

(2.) 1¼-inch valve, No. 889, dimensions are—

Diameter of steamway	1.26 inches.
" at top of ground joint	1.38 "
" at outside of upper edge of adjustable ring	1.76 "
" at inside edge of lip	1.85 "
Horizontal width of outlet at lip	.045 "
Overlap	.035 "

332 The spring is composed of 8½ turns of steel .20 inch square; outside diameter of spring, 1.35 inches; length when free, 2.90 inches; length when compressed to working pressure, 2.69 inches; compression at 99 pounds, .21 inch.

Result of test, Monday, Oct. 4, 1886, is shown in the following table:

Mr. Harrison's Test of Complainants' Valve, 1¼ Inch, No. 889.

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.05	----	99	94 5	4.5
"	----	98.5	94	4.5
"	----	99	94	5
"	----	97.5	94	3.5
"	----	99	92	7

(3.) 1½-inch valve, No. 487, dimensions are—

Diameter of steamway	1.50 inches.
" at top of ground joint	1.65 "
" at outside of upper edge of adjustable ring	2.07 "
" at inside edge of lip	2.14 "
Horizontal width of outlet at lip	.035 "
Overlap	.02 "

The spring is composed of 7 turns of steel .20 in. square; outside diameter of spring, 1.25 in.; length when free, 2.85 in.; length when compressed to working pressure, 2.57 in.; compression at 96½ lbs., .28 in.

Result of test is shown in the following table:

Mr. Harrison's Test of Complainants' Valve, 1½ Inch, No. 487.

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.07	No warning.	99.5	92.5	7
"	"	96	92.6	3½
"	"	96.5	92.5	4
"	"	96.5	92.5	4
"	"	96.5	92.5	4
"	"	96.5	92.5	4
"	"	96.5	92.5	4

(4.) 2-inch valve, No. 123, dimensions are—

Diameter of steamway	2.01 inches.
Diameter at top of ground joint	2.18 "
333 Diameter at outside of upper edge of adjustable ring	2.67 inches.
Diameter at inside edge of lip	2.73 "
Horizontal width of outlet at lip	.03 "
Overlap	.01 "

The spring is composed of 6½ turns of steel .28 inch square; outside diameter of spring, 1.75 inches; length when free, 3.85 inches; length when compressed to working pressure, 3.60 inches; compression at 76 pounds, .25 inch.

Result of test is shown in the following table:

Mr. Harrison's Test of Complainants' Valve, 2 Inch, No. 123.

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.05	75.5	78	74	4
"	76	78	74	4
"	76	76.5	74	1.5
"	75.5	76	74	2
"	75.5	76	74	2
"	No warning.	76	74	2
"		76	74	2
"		76	74	2

(5.) 2½-inch valve, No. 148, dimensions are—

Diameter of steamway	2.51 inches.
" at top of ground joint	2.69 "
" at outside of upper edge of adjustable ring	3.37 "
" at inside edge of lip	3.47 "
Horizontal width of outlet at lip	.05 "
Overlap	.02 "

The spring is composed of 7½ turns of steel ⅜ inch square; outside diameter at spring, 2.28 inches; length when free, 4.88 inches; length when compressed to working pressure, 4.48 inches; compression at 76½ pounds, .40 inch.

Result of test is shown in the following table:

Mr. Harrison's Test of Complainants' Valve, 2½ Inch, No. 148.

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.08	No warning.	76.5	74.5	2
"		76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"

334 (6.) 3-in. valve, No. 188, dimensions are—

Diameter of steamway	3.01	inches.
" at top of ground joint	3.25	"
" at outside of upper edge of adjustable ring	4.18	"
" at inside edge of lip	4.26	"
Horizontal width of outlet at lip	.04	"
Overlap	.02	"

The spring is composed of 7 turns of steel $\frac{7}{16}$ inch square; outside diameter of spring, 2.40 inches; length when free, 4.95 inches; length when compressed to working pressure, 4.65 inches; compression at 77½ lbs., .30 inch.

Result of test is shown by the following table:

Mr. Harrison's Test of Complainants' Valve, 3 Inch, No. 188.

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.08	75.5	77.5	75	2.5
"	76	77.5	75	2.5
"	75.5	77.5	74.5	3
"	75.5	77.5	74.5	3
"	75 5	77.5	74.5	3

(7.) 3½-in. valve, No. 123, dimensions are—

Diameter of steamway	3.51	inches.
" at top of ground joint	3.72	"
" at outside of upper edge of adjustable ring	4.84	"
" at inside edge of lip	4.92	"
Horizontal width of outlet at lip	.04	"

No overlap. There is, however, a clearance of .01 in. which the lower edge of the lip is above the top edge of adjustable ring.

The spring is composed of 6½ turns of steel ½ inch square; outside diameter of spring, 3.15 inches; length when free, 5.40 inches; length when compressed to working pressure, 5 inches; compression at 76½ pounds, .40 inch.

Result of test is shown by the following table:

Mr. Harrison's Test of Complainants' Valve, 3½ Inch, No. 123.

	Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
	.08	No warning	76	73	3
	"		76	73.5	2.5
	"		76	73.5	2.5
335	.08	No warning.	76	73.5	2.5
	"		77	73.5	3.5
	"		76	73.5	2.5
	"		77.5	73.5	4
	"		76.5	73.5	3
	"		76.5	73.5	3

(8.) 4-in. valve, No. 130, dimensions are—

Diameter of steamway	3.99	inches.
" at top of ground joint	4.21	"
" at outside of upper edge of adjustable ring	5.60	"
" at inside edge of lip	5.66	"
Horizontal middle of outlet at lip	.03	"

Overlap taken as nothing, daylight being visible in a fine line between the lower edge of lip and the upper edge of the adjustable ring.

The spring is composed of six turns of steel $\frac{9}{16}$ inch square; outside diameter of spring, 3.50 inches; length when free, 5.95 inches; length when compressed to working pressure, 5.50 inches; compression at 77½ lbs., .45 inch.

Report of test is shown by the following table:

Mr. Harrison's Test of Complainants' Valve, 4 Inch, No. 130.

Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
.06	77	78	74	4
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5

Int. 34. Give dimensions of Defendants' Exhibit 14 and Complainants' Exhibit C and the result of the test of each.

Ans. The dimensions of Defendants' Exhibit 14 are—

Diameter of steamway	2.26	inches.
" at top of ground joint	2.54	"
" at outside of valve seat at upper edge	3.18	"
" of the inside of adjustable lip at lower edge	3.28	"
Horizontal width of outlet at lip	.05	"
Overlap	.02	"

336 The spring is composed of 7 turns of steel $\frac{3}{8}$ inch square; outside diameter of spring, 2.20 inches; length when free, 4.10 inches; length when compressed to working pressure, which was 100 lbs., 3.80 inches; compression at 100 lbs., .30 inch; length when set for 123 lbs. working pressure, 3.70 inches; compression at 123 lbs., .40 inch.

There were two sets of experiments made with this valve: one with a boiler pressure of 100 lbs., and the other with a boiler pressure of 123 lbs., the results of which are fully set forth in the following table:

Mr. Harrison's Tests of Defendants' Exhibit 14.

Remarks.	Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Tested at 100 pounds per square inch boiler pressure.	.03	No warning.	100	99½	½
	"	"	100	99½	½
	"	"	100	99½	½
	"	"	100	99½	½
	"	"	100	99½	½
The spring was then tightened, and boiler pressure ran up to 123 pounds, and these results obtained.	.03	No warning.	123	119	4
	"	"	123	119	4
	"	"	123	119	4
	"	"	123	119	4
	"	"	123	119	4
	"	"	123	119	4

As to Complainants' Exhibit C, I notice that this valve has no adjustable feature for its overlap. Its dimensions are—

Diameter of steamway	2.25	inches.
" at top of ground joint	2.55	"
" at outside of top of valve seat	3.17	"
" at inside of lower edge of lip	3.28	"
Horizontal width of outlet at lip	.055	"
Overlap	.03	"

The spring is composed of 7½ turns of steel, .36 inch square; outside diameter of spring, 2.25 inches; length when free, 4.44 inches; length when compressed for working pressure of 100 pounds, 3.94 inches; compression at 100 pounds, .50 inch = ½ inch; compression of spring with a working pressure of 123 pounds, .625 inch = ⅝ inch.

With this valve I made two sets of experiments: one at 100 pounds and the other at 123 pounds boiler pressure. The results are shown by the following table:

337 *Mr. Harrison's Tests of Complainants' Exhibit C.*

Remarks.	Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Spring compressed ½ inch.	.05	No warning.	100	97	3
	"	"	100	97	3
	"	"	100	97	3
	"	"	100	97	3
	"	"	100	97	3
Spring compressed ⅝ inch to make valve pop at 123.	.05	No warning.	123	114½	8½
	"	"	123	114½	8½
	"	"	123	114½	8½

Int. 35. Have you compiled a table of like dimensions of the valves testified of in the last three questions, and of corresponding dimensions of Defendants' Exhibits Richardson's Valve Like Photolithograph Drawing and Richardson's Valve from Original Drawing? If so, please produce it and make it part of your answer.

Ans. I have, and I produce it. It is as follows:

Table of Dimensions of Richardson's and Complainants' Valves.

Name of valve.	DIAMETERS IN INCHES. Steamway.	Top of ground joint.	Outside of valve seat.	Inside of lip.	Width of outlet.	Overlap.	Remarks.
Defendants' Exhibit Richardson Valves Like Photolithograph drawing.	1.34	1.65	1.94	1.96	.01	.025	
Defendants' Exhibit Richardson Valve from Original Drawing, 1866.	2¼	2.73	3.228	3.26	.016	.03	
			Outside adjustable ring on valve body.				
Consol. Valve Co.	¾	.84	1.08	1.11	.015	.00	
" " "	1	1.10	1.37	1.44	.035	.03	
" " "	1¼	1.38	1.76	1.85	.045	.035	
" " "	1½	1.65	2.07	2.14	.035	.02	
" " "	2	2.18	2.67	2.73	.03	.01	
Defend. Exhibit 14.	2¼	2.54	3.18	3.28	.05	.02	Ring on lip.
Comp. " C.	2½	2.55	3.17	3 28	.055	.03	No ring.
Consol. Valve Co.	2½	2.69	3.37	3.47	.05	.02	
" " "	3	3.25	4.18	4.26	.04	.02	
" " "	3½	3.72	4.84	4.92	.04	.00	Clearance.
" " "	4	4.21	5 60	5.66	.03	.00	

338 Int. 36. Have you also compiled a table showing in Defendants' Exhibits of Richardson's and Complainants' Valves and Complainants' Exhibit C, above mentioned, the size, the operation under steam, the lift of the valve at such time, and the area of the openings, both at the ground joint and at the outlet, and the ratio of those two openings? If so, please produce it and make it part of your answer.

Ans. I have, and I produce it. It is as follows:

Table of Areas of Openings.

Diameter of steamway.		Lift of valve, inches.	AREAS OF OPENINGS, IN SQUARE INCHES.			STEAM PRESSURE IN BOILER, IN POUNDS, PER SQUARE INCH.		
			At ground joint.	At outlet.	Ratio.	Open.	Close.	Reduction.
1.34	Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing.	.05	.1805	.1649	1 : .91	100	72½	27½
2½	Defendants' Exhibit Richardson Valve from Original Drawing, 1866.	.0555	.3562	.3026	1 : .86	100	71	29
¾	Con. Valve Co.	.03	.0560	.1154	1 : 2.06	100	97	3
1	" " "	.03	.0730	.1545	1 : 2.10	93½	92	1½
1¼	" " "	.05	.1533	.2688	1 : 1.75	99	94	5
1½	" " "	.07	.2564	.4036	1 : 1.57	96½	92½	4
2	" " "	.05	.2420	.4240	1 : 1.75	76	74	2
2½	Def. Ex. 14.	.03	.1693	.5175	1 : 3.05	100	99½	½
2½	Comp. Ex. C.	.05	.2832	.5926	1 : 2.09	100	97	3
2½	Con. Valve Co.	.08	.4780	.8391	1 : 1.75	76½	74½	2
3	" " "	.08	.5744	.9560	1 : 1.66	77½	74½	3
3½	" " "	.08	.6610	1.507	1 : 2.28	76½	73½	3
4	" " "	.06	.5610	1.186	1 : 2.11	77½	74	3½

Int. 37. The complainants' valve, 1 to 4 inches, you have said you tested, without disturbing, as received. Now, the ¾-inch valve and Defendants' Exhibit 14 and Complainants' Exhibit C were not set at any particular pressure when you made your trials, were they? and, if not, at what pressure did you set them?

Ans. They were not. I set the ¾-inch valve to pop at 100 lbs. boiler pressure, Defendants' Exhibit 14 at 100 lbs. boiler pressure in one series of experiments and at 123 lbs. in the other series, and Complainants' Exhibit C at 100 lbs. in one series and at 123 lbs. in the other series of experiments.

Int. 38. When did you make the measurements of the Richardson's and complainants' valves?

Ans. On the days following the experiments.

339 Int. 39. How did you get at the valves to make those measurements?

Ans. In the brass valves, by unscrewing the case from the castings of the seat without disturbing the top part of the valve—that is, the measurements of the valves. In the iron-cased valves it was necessary to withdraw the screw-plug which serves as a keeper for preventing accidental disturbance of the adjustment of the adjustable ring; then, by taking out the bolts from the flange, I was enabled to lift the valve case bodily from the lower iron castings of the valve without changing the adjustment of the ring.

Int. 40. Could you then get at all parts of the valve and body?

Ans. I could.

Int. 41. On the brass valves, how are the adjustable rings spoken of by you located and held in place?

Ans. They are located on the valve-seat casting and surrounding it. They are held in place by a brass wire which is driven through a suitable notch, provided for that purpose when the valve is made, into the seat.

Int. 42. Whether or not those rings or fastenings were ever disturbed or have been disturbed?

Ans. They have not.

Int. 43. As to the iron valves, where is the adjustable ring located on them and how is it held in place?

Ans. It surrounds the brass casting which forms the valve seat, and is held in place by a screw-plug, as I have before described.

Int. 44. After the measurements were made, who assembled and put the parts of valves together?

Ans. I did.

Int. 45. Whether or not there was any change of these parts from their location or position when received and tested by you?

Ans. There was no change.

Int. 46. How did you find the area of the opening at the ground joint, which has been already given for each valve?

Ans. The Richardson valves I took the diameter at top of the ground joint and subtracted from that half the lift, then from that remainder I calculated the mean circumference of the opening. This circumference, multiplied by the width of the opening, 340 gives the area at the ground joint, and the width of opening was calculated by multiplying the lift of the valve by the natural sine of the angle of the valve face from a perpendicular. This angle for the small valve was taken at 45 degrees, and the natural sine of 45 degrees is .707. The angle of the valve face from a perpendicular in the Richardson valve, made from the original drawing, was 50 degrees, and the natural sine of an angle of 50 degrees is .766.

In my calculations on the Consolidated Valve Company's valves, ¾ in. to 4 in., inclusive, and also Defendants' Exhibit 14 and Complainants' Exhibit C, I took the actual diameter at top of the ground joint, and from that diameter calculated the circumference without making any reduction. This circumference so taken, multiplied by the width of opening, gives an approximate area, which does not exceed the true area more than 2 per cent. The angles of all these valves were taken as being 45 degrees. Some of them vary slightly from that, but not to any great extent.

Int. 47. When you put these valves together, after making the measurements, did you deliver them to Mr. William Burnett for trial, and were you present at a trial of them by him?

Ans. I did deliver them to him and was present at a trial.

Int. 48. Whether or not they were in the same condition when so delivered, as to location of all the parts, as when you made tests with them?

Ans. They were.

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 49. Please describe in full the apparatus with which you made what you have been pleased to call tests of these various valves; and, if any change, even of the minutest character, was made between one of the performances, which you have been pleased to call a test, and another, state what that change was.

Ans. Well, I declare, I do not know how to answer that question. I do not understand the question.

Cross-int. 50. Did you have any apparatus to test them with?

Ans. I had a steam-gauge.

Cross-int. 51. Was that all?

341 Ans. And book and pencil.

Cross-int. 52. Was that all?

Ans. And boiler and valves connected therewith.

Cross-int. 53. Was that all?

Ans. Grate bars and firing tools.

Cross-int. 54. Anything else?

Ans. I had some little wires which were inserted in these brass valves for the purpose of determining the lift, and I had some little plugs which we used with the defendants' Webster exhibits for determining the amount of overlap or immersion of the lip of the valve, and I had my two-foot rule and scale rule. In some cases I had some sticks with which I measured the lift at the end of lever. I also had some monkey-wrenches—Stillson wrench—that is, pipe wrench, two or three of them; that is all I think of now, except the exhibits themselves.

Cross-int. 55. Be kind enough to give me the sizes and numbers of the Stillson wrenches.

Ans. I would be pleased to give them if I knew what they were.

Cross-int. 56. You can't give any of them, can you?

Ans. I cannot.

Cross-int. 57. What sort of a scale rule did you have?

Ans. United States standard, Brown & Sharp's make, graduated to hundredths.

Cross-int. 58. What did you use that for?

Ans. Measuring.

Cross-int. 59. Measuring what?

Ans. Measuring the lifts of the valves, in some cases.

Cross-int. 60. Is that all?

Ans. I think that is the only thing I used it for during the experiments.

Cross-int. 61. Was it the only thing you used it for, at any time, connected with the facts or opinions concerning which you have testified in this case; and, if not, what else did you use it for in that regard?

Ans. I used the scale spoken of in a large number of my measurements where accuracy was required.

Cross-int. 62. Which were those?

342 Ans. Nearly all of them.

Cross-int. 63. Tell me in what measurements you didn't use this scale?

Ans. In certain measurements which I made showing the lift at the end of the lever in some of the Webster valves experiments, in which case I used an ordinary two-foot rule.

Cross-int. 64. You didn't think accuracy was required in them, then?

Ans. I could read the measurement on the two-foot rule to the

half a sixteenth of an inch, and whatever the error was was reduced to a very small amount by dividing by the lever ratio.

Cross-int. 65. You used this Brown & Sharp scale for all the other measurements, did you?

Ans. I had another measuring instrument of equal accuracy, called "beam calipers." I used these wherever the form of the object made it most convenient.

Cross-int. 66. What cases were those?

Ans. Some cases of diameters of the steamway, and also the diameters inside of lip.

Cross-int. 67. What became of the sticks which you measured with?

Ans. I don't know.

Cross-int. 68. What became of the "some little plugs" used with the Webster exhibits?

Ans. I think I have them now.

Cross-int. 69. Where?

Ans. In my drawer at the Crosby Gage Company's shop.

Cross-int. 69½. What are they made of?

Ans. Brass.

Cross-int. 70. What became of "the little wires" used for determining lift?

Ans. I do not know.

Cross-int. 71. Now, you have spoken of grate bars and firing tools. What firing tools did you use or see used during these experiments?

Ans. I saw a shovel and a pricker bar.

Cross-int. 72. And what grate bars did you see used? How long, how wide, how deep, and of what construction?

343 Ans. They were ordinary bars; the dimensions I do not know.

Cross-int. 73. What valves were connected with the boiler which constituted any part of the apparatus with which you made these tests?

Ans. There were two valves; what I should call gate valves.

Cross-int. 74. Where were these valves located with regard to the boiler and with regard to the valve that you were trying to test?

Ans. They were placed on top of the boiler. There was one large gate valve permanently attached on the top of the boiler. There was also another valve above that, which may be removed when an extra large safety-valve is to be tested, and the safety-valves to be tested are placed above one or two of these gate valves.

Cross-int. 75. Was there any connection between the two gate valves?

Ans. When the lower gate was open steam passed freely to the upper gate valve, and when the upper gate was opened steam passed freely to the safety-valve being tested.

Cross-int. 76. Do you mean by that that between the upper and the lower gate valve there was a steam-pipe, or that there was not a steam-pipe?

Ans. I mean that one valve was bolted directly to the other.

Cross-int. 77. Now, was the lower gate valve bolted or attached directly to the boiler?

Ans. I think not.

Cross-int. 78. Was the safety-valve tested by you in the experiments you have described connected directly to the upper gate valve; and, if not, what was the interval, as near as you can give it, between the gate of the upper gate valve and the valve under test?

Ans. In the case of all the valves, about eight inches.

Cross-int. 79. And what was the size of the pipe between the upper gate valve and the valve under test?

Ans. There was no pipe.

Cross-int. 80. Well, steam cavity? Give me the diameter of the walls of this eight-inch-long cavity in which there was steam at the time your valves were tested, between the gate of the upper gate valve and the valve in test.

Ans. The diameter varied from the diameter of the steam-
344 way of the safety-valve being tested to the diameter of the outlet of the gate valve. I do not know the diameter of the outlet of the gate valve.

Cross-int. 81. Between the gate valve and the steamway of the valve under test was the cavity which contained the steam of uniform cross-section, or did it vary?

Ans. It varied.

Cross-int. 82. Describe it as near as you can.

Ans. The cavity, I should judge, was a succession of short cylinders, the largest being at the bottom and the smallest at the top.

Cross-int. 83. Now, between the lower gate valve and the boiler was there any steamway; and, if so, how long, how large transversely, of what shape, and of what form and direction of route?

Ans. I do not know as to the size of that opening. I know that the valve itself, the centre of the lower gate valve, was within about eighteen inches of the top of the boiler. I know that the route of the steam was upward, and I can only infer that the form of the opening was cylindrical because other openings are usually made that way, but the dimensions of it I do not know.

Cross-int. 84. You have given the steam pressure at the time of the closing of these valves which you tested. Whereabouts was the steam-gauge attached to the boiler or steamway for the purpose of ascertaining these pressures—on the boiler, between the boiler and the lower gate valve, between the two gate valves, between the upper gate valve and the valve under test, or to some part of the valve under test?

Ans. In my tables of experiments I have stated that the boiler pressures were those referred to, and the gauge by which these pressures were indicated was connected with the upper part of the boiler.

Cross-int. 85. Then when you blew down twenty-nine or thirty pounds of steam you always took that amount of steam from the whole body of the boiler, did you?

Ans. Well, the whole body of the boiler wasn't filled with steam.

Cross-int. 86. You took that amount of steam pressure from the whole body of the boiler, did you?

345 Ans. I did.

Cross-int. 87. About how long was the boiler employed in these tests?

Ans. I can only guess; I should say about eight feet high.

Cross-int. 88. Was it a vertical or a horizontal boiler?

Ans. A vertical boiler. I should increase that and call it ten feet high.

Cross-int. 89. About what diameter was the boiler?

Ans. I should say about four feet and a half, for another guess.

Cross-int. 90. Did it rest upon the same floor of the building in which you were making your tests?

Ans. It did. I should correct that. Where I stood to make my tests was on a grating, which you might call a floor, located about the height of the top of the boiler.

Cross-int. 91. Then you could observe the firing of this boiler and what was going on about it, could you?

Ans. Yes, sir.

Cross-int. 92. Do you remember what kind of coal was used in these tests, whether anthracite or bituminous?

Ans. Bituminous.

Cross-int. 93. In no instance, then, as I understand you, was any valve concerning which you have testified tested under your observation unless the full power of the boiler was exerted to lift it and hold it open until it had blown off the steam necessary to reduce the pressure the amount which you have testified to?

Ans. In the case of the valves which were tested at 100 lbs., a hundred pounds pressure in the boiler was required to open them, and they closed when the boiler pressures had been reduced the amounts stated in my tables.

Cross-int. 94. Please answer the question.

Ans. I don't understand what is meant by the term "power of the boiler."

Cross-int. 95. Was, in any instance, in the testing of the valves you have testified about, a valve between the safety-valve and the body of the boiler wholly or partly closed during the blowing of the valve?

Ans. No, sir.

346 Cross-int. 96. Do you mean to say that when you tested the valves, Exhibit Webster, Fig. 3; Exhibit Webster, Fig. 1; Exhibit Webster Valve, with flange resting on top of valve, and Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing, the several conditions of test were, except the pressure in the boiler and the size of the coupling between the boiler and the valve, in all respects the same as when you tested Defendants' Exhibit Complainants' Valves, 4 in., 3½ in., 3 in., and 2½ in.?

Ans. Well, the size of the coupling between the boiler and the valve wasn't changed, because there was no coupling there. The conditions were in all respects the same, excepting that with the

small valves more bushings were required to reduce the diameter of the gate valve down to the required diameter.

Cross-int. 97. When you say to reduce the diameter of the gate valve down to the required diameter you understand this not to be a change of the coupling between the boiler and the valve, do you?

Ans. There was no coupling between the boiler and the valve—I mean the gate valve.

Cross-int. 98. Do you mean to say that when you tested the safety-valves, Exhibit Webster, Fig. 1 and Fig. 3, and with flange resting on top of valve, and Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing there was no difference in the sizes of the connections between said safety-valves and the boiler from what there was in the connections between the safety-valve and the boiler when you tested Defendants' Exhibit Complainants' Valves, 4 in., 3½ in., 3 in., and 2½ in.?

Ans. I do, with the exception which I have already named.

Cross-int. 99. Then you used the same sized steamway between the upper gate valve and the valve under test for the 4-inch valve that you did for the small Webster valve, did you?

Ans. It was the same, except that the mechanical requirements of case required the introduction of bushings to reduce the diameter.

Cross-int. 100 Did this reduction of diameter reduce the size of the steamway?

Ans. It reduced the size of one end of it—that end nearest the safety-valve.

Cross-int. 101. When you, as an engineer, proportion the
347 size of a steamway for a given purpose, do you consider that that steamway is any larger than the smallest cross-section of it?

Ans. Why, of course it is larger where it is larger.

Cross-int. 102. Is it larger for the passage of steam than its smallest section?

Ans. In case of a pipe of any appreciable length, the large pipe will discharge more steam than a small pipe, the size of the discharge hole being the same in each case.

Cross-int. 103. How long did it take the Richardson valve from photo-lithograph drawing to blow down the observed amount in each instance that fell under your observation?

Ans. I cannot tell. I do not remember.

Cross-int. 104. Can't you state somewhere between a minute and a month?

Ans. Well, I'd rather not attempt to state.

Cross-int. 105. Will you be kind enough to give me that information, as near as you can give it? There must be some time that it didn't exceed, and I'd like that as near as you can give it.

Ans. I should say about four minutes.

Cross-int. 106. And how long did it take the Webster valve to blow its blow in the best time that it did the work that you observed, stating particularly as to Exhibits Figs. 1 and 3?

Ans. It depended upon the amount of the overlap to which the Webster valve was adjusted. Oh, the best work, quarter of a minute.

Cross-int. 107. And how was it with the Webster valve with the flange resting on top of the valve?

Ans. That took a little more time; possibly two minutes—three minutes.

Cross-int. 108. And how was it with complainants' valve, 4 in., as to time?

Ans. About ten seconds, when the fire was in good order.

Cross-int. 109. There was no arrangement for connecting a gauge, as I understand you, and no gauge connected, on which you took observations, between the upper and lower gate valves?

Ans. No, sir.

(Adjourned.)

348 JAN. 3, 1887.

Cross-int. 110. With this Exhibit Richardson Valve from Photo-lithograph Drawing you got your best results, did you not, with regard to loss and percentage of loss, with your strongest spring?

Ans. Yes, sir.

Cross-int. 111. Did you make any alterations in the width of stricture in any of your experiments with this exhibit from the photo-lithograph drawing?

Ans. No, sir.

Cross-int. 112. You found, then, that the regulation of the escape of steam which you obtained was as required by you?

Ans. I found that the springs which I used produced the effect stated in my tables.

Cross-int. 113. And you didn't attempt to follow the instruction of Richardson in order to get a better or different effect by changing the size of the stricture, did you?

Ans. I made no change in the size of the stricture.

Cross-int. 114. Was the reason that you made no change in the size of the stricture because you had got in the working of the valve a difference between the opening and closing pressure such as *as* you required, or such as was required of you, or did you have any other reason?

(Objected to by defendants because the question goes to the motive, which imputes dishonesty to the witness rather than mechanical facts.

Insisted on by complainants because the patent goes to the motive of the tester in these words: "For a strong spring or balance this space should be diminished, and for a weak spring or balance it should be increased, to regulate the escape of steam as required."

Objected to further by the defendants because the witness has testified that the valve inquired about was made exactly according to the drawing followed, and that his tests made of it were by using three springs ranging from 80 lbs. to 140 lbs., to wit, one spring from 80 to 100, one from 100 to 120, and one from 120 to 140 lbs., and that there was substantially the same percentage of loss in each case, and that the motive or intention was to find out by these springs of dif-

ferent powers just what the patent meant by the size of the
349 stricture being regulated to the strength of the spring, and that therefore the motive of the witness had nothing to do with the matter beyond this.)

MASTER: This is a cross-examination of an expert and the question may be put.

Ans. I had no reason, only to get at the truth in regard to the construction and operation of these valves.

Cross-int. 115. Were you aware that it is in evidence in this case that the ordinary spring for a spring-loaded safety-valve at the time of the Richardson patent had a compression or tension equivalent to a compression of a quarter of an inch for 100 lbs. immediately over the valve?

Ans. I was not.

Cross-int. 116. Assuming that to be the definition of an ordinary spring, which of those three springs, namely, the one compressed to .50 in., the one compressed to .35 in., or the one compressed to .20 in., for your experiments of Nov. 16 and 17, 1885, and Oct. 23, 1886, was the nearest to an ordinary spring?

(Objected to, as there are no elements given as to the size, length, or diameter or size of steel used in the construction of such spring, there being nothing to make a comparison with.)

Ans. As regards the amount of the compression, the spring which is marked 125 to 140 is the nearest, the amount of the compression being .20 in. If the spring had been a little longer, the compression on the valve would have been greater; the lift of the valve would also have been greater, and the amount of steam taken out would also have been greater.

Cross-int. 117. Which do you call the stronger spring—a spring which is compressed more than .2 in. for a given pressure or a spring that is compressed just .2 in. for a given pressure?

Ans. The two statements are not comparable, for the reason that the comparative length of the springs is not stated.

Cross-int. 118. Then you think that it is possible for a spring which 100 lbs. will compress a quarter of an inch to be as strong as a spring which 100 lbs. will compress less than a quarter of an inch, do you, if they are of different lengths?

Ans. Certainly, one is as strong as the other as long as they hold back the same steam pressure.

350 Cross-int. 119. How old were you in 1866?

Ans. Dec. 25, 1866, I was twenty-six years old.

Cross-int. 120. Do you know whether, in the year 1866, that which you have given as the meaning of a strong and weak spring, as regards the springs of spring balances and safety-valves, was the ordinary and current significance of those words as applied to spring balances on safety-valves among the engineers who used them?

Ans. I do not.

Cross-int. 121. With regard to the Richardson valve from original

drawing, were your experiments with that made with the lever arrangement now upon it?

Ans. They were.

Cross-int. 122. Mr. Hoadley states that the leverage of that valve is 9 to 1, and you state that the extension of one of your springs at 100 lbs. pressure was $2\frac{9}{16}$ in. and of the other one $1\frac{5}{16}$ in. in the experiments made by you Dec. 21 and 22, 1885. That would be equivalent to a compression, if a spring were directly over the valve, of about .216 in. in one case and about .285 in. in the other, would it not?

Ans. Well, I don't understand fully what is meant by the term "equivalent to."

Cross-int. 123. I mean by that exactly what your coadjutor, Mr. Hoadley, meant in these two phrases used with regard to the materials of the experiments of Dec. 21 and 22, 1885:

"The spring made from No. 7 wire was equivalent to 0.32 in. compression directly over the valve."

"Another and a stronger spring, made of No. 6 wire, equivalent to 0.215 in. compression directly over the valve."

Ans. My figures for the extension of the No. 7 wire spring are $2\frac{9}{16}$ in., which I have already testified to, and Mr. Hoadley, through a mistake, gave a greater extension than was shown by the spring, which mistake was that he measured the spring, and I measured the spring before it was used; I then measured the spring after it had been used, and with my rule upon it called the attention of Mr. Hoadley to the fact that the length of the spring was 7 in., the same as now when not strained, and at the time I supposed that he had made a note of it. The fact was that the spring had taken a
351 permanent set or extension, which is a very common thing with new springs.

I might state here that all my statements with regard to length of springs, when not strained or compressed, refer to their present length.

The results of the calculations in the questions are substantially correct.

Cross-int. 124. You have stated, with regard to the Waterman exhibit introduced, that you filled the dash-pot with water. Has there not been oil in that dash-pot?

Ans. There has.

Cross-int. 125. In the table which you have given in answer to Int. 36 you have made three columns under the general heading, "Areas of openings in square inches," and under the special headings, "At ground joint," "At outlet," and "Ratio." What part of the ground joint was measured to get the area of its opening for the ground-joint column, the top circumference, the bottom circumference, or an intermediate circumference?

Ans. I measured the diameter at top of the ground joint—not the circumference.

Cross-int. 126. Where does the steam enter the ground joint from the pipe leading to it—at its least diameter or at its greatest diameter?

Ans. Least diameter.

Cross-int. 127. Where is it expected that a valve will seat at the ground joint—on its least diameter or on its greatest?

Ans. I don't understand the question.

Cross-int. 128. What other factor than the diameter of the ground joint at its upper edge did you take to get the area of the opening at the ground joint?

Ans. The lift of the valve.

Cross-int. 129. You multiplied the diameter of the ground joint by the lift of the valve, did you?

Ans. I did not.

Cross-int. 130. What other factor did you use?

Ans. The constant multiplier for circumferences, called π, which means 3.1416.

352 Cross-int. 131. What factors did you take to get the area of the opening at the outlet?

Ans. I took the diameter of the outside of the valve seat, or, in most cases, the outside of the adjustable ring on the valve seat at its upper edge, added to it the width of the outlet for an average diameter for the annular outlet opening. This multiplied by 3.1416 gives the average circumference of this annular outlet. The area of the annular opening is calculated by multiplying the circumference already found by the shortest distance between the outside edge of the valve seat or adjustable ring and the inside of the overhanging lip. This distance will usually be the hypothenuse of a little right-angle triangle, having for its base a length equal to the horizontal width of the outlet and for its perpendicular a distance which is equal to the lift of the valve, minus the overlap in case there be overlap, plus or minus nothing in case the lip of the valve is flush with the valve seat, and plus the amount of clearance in case the lip is above the valve seat when the valve is closed.

Cross-int. 132. You give a long description, in answer to Int. 46, of the way in which you calculated the opening at the ground joint of the Richardson valves. Will you please tell me what you mean by the Richardson valves in that answer?

Ans. I mean the exhibits here, Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing and Defendants' Exhibit Richardson Valve from Original Drawing.

Cross-int. 133. That is, what you are pleased to call Richardson valves in answer to Int. 46 were valves which, so far as you know, were made by the Crosby Steam Gage and Valve Company and not made by Richardson or his assignees or others representing him. Is that so?

Ans. These valves were made under my observation, strictly to the photo-lithograph of drawing and strictly to the certified copy of the original drawing.

Cross-int. 134. You have said "photo-lithograph of drawing." Do you know of your own knowledge, or have you the slightest reason to believe on inspection, when you consider the place where the letters F, A, D, E are located in Fig. 3 of the lithograph and of the tracing, that the photo-lithograph was made from any

353 drawing of which the tracing produced is an exact tracing? And please also observe in this connection the letters B, in Figs. 3 and 4.

Ans. This photo-lithograph drawing has connected to it by a ribbon and seal a leaf which states: "This is to certify that the annexed is a true copy from the records of the office of the letters patent granted George W. Richardson Sept. 25, 1866, No. 58294, for improvement in safety-valves," with the usual formalities and name of the Commissioner signed. In addition to this, I would state that I do not consider the letters or the location of the letters on the drawing as being in any regard a guide for the constructor of this valve. Furthermore, I notice an additional difference, which is that the photo-lithograph reproduction is cross-hatched on the sectional drawings. Taking these two things together, I conclude that the photo-lithographic reproduction is a correct process copy of the original drawing in every way except size. Further, I know that this tracing, which has attached to it the certification "that the annexed is a true copy from the records of this office," etc., was made by hand by a draughtsman, and I do know, as a draughtsman of large experience, that the exact location of letters or the exact form of letters is not considered important. I further know, as a draughtsman of large experience, that, to save work and also to make a better and more useful drawing, the cross-hatching may be dispensed with without in any way impairing the accuracy of the traced work.

From the foregoing, I have every reason to believe that these two drawings are correct representations of the drawings accompanying the Richardson patent of Sept. 25, 1866.

Cross-int. 135. Do you mean by all that that you do think that the photo-lithograph was photographed originally from the drawing from which the tracing was made, and that the tracing is defective, or that the photo-lithograph was not photographed from the drawing from which the tracing was made?

Ans. I certainly think that the photo-lithograph is a true copy, as stated in the certification, but I do not think either that the full-sized tracing is in any way defective; but I do think that the omission of cross-hatching is a great improvement, as a large number of lines are left out which should never be put into a drawing from which work is to be constructed.

354 Cross-int. 136. If you should be informed, and it shold be a fact, that the original drawing filed by Richardson had no cross-hatching upon it whatever, but was tinted yellow where cross-hatching appears on the photo-lithograph, you would hold to your view, I suppose, that the cross-hatched photo-lithograph was photographed from the original drawing filed by Richardson, would you?

Ans. When Richardson's patent was taken the photo-lithograph process was not in use in the Patent Office, and it is very likely that the cross-hatching may have been added to it, particularly as I notice here a solid line showing the under side of the valve, which would not have appeared had the original draughtsman intended cross-hatching.

Cross-int. 137. Do you mean by all that that if the drawing filed by Richardson in the Patent Office now, to-day, has no cross-hatching upon it, but does have in place of the cross-hatching a yellow tint, you would still hold that the photo-lithograph was photographed from that original drawing?

Ans. The cross-hatching could readily be done on the stone or plate of the photo-lithograph, or, in any case, without further evidence, I should believe that, as certified, "the annexed is a true copy from the records of this office."

Cross-int. 138. Then you are of the opinion, are you, that the same drawing furnished the object from which the photograph of the photo-lithograph was taken and over which the tracing was made?

Ans. That is my belief, having before me the certifications of the Patent Office.

Cross-int. 139. Why didn't you measure and calculate the Defendants' Exhibits Complainants' Valves according to the same system adopted in measuring and calculating the defendants' exhibits, which you have been pleased to call Richardson valves, but which were not made by Richardson or under his supervision?

Ans. the reason for that was that when I made those calculations I had a large number to make, and the method which I used, namely, by use of logarithms, was rendered much simpler by leaving out the reduction of diameter which occurs in the calculations for the Richardson valves. The error being known and being small, in the case of the 4-inch valve amounts to less than $\frac{3}{4}$ of one per
355 cent. of the area of the opening at the top of the ground joint, being a result that much greater than the true area.

Cross-int. 140. So that whatever error there was exaggerated your ratio in the third column of the table we have referred to, did it not?

Ans. The ration in the table is somewhat less than the true ratio. The ratios in the table which refer to the two Richardson valves are the true ratios.

Cross-int. 141. Which end of the ratio is less, the ground-joint end or the outlet end?

Ans. In the case of the two Richardson valves the outlet area is smaller than the area at top of ground joint. In the other valves in the table the outlet at the lip of the valve is very much larger than the area of the opening at the ground joint.

Cross-int 142. Have you answered my question, which end of the ratio is less, in the same sense of the word "less" in which you used that word in the expression, "The ratio is somewhat less than the true ratio"?

Ans. I don't understand the question.

Cross-int. 143. When you said the ratio is somewhat less than the true ratio, with regard to the valves in your table, classified from $\frac{3}{4}$ to 4 inches, the column of ratios showing a relationship in which 1 is the first term and some quantity greater than 1 the second term, would you be obliged, in order to express the true ratio, to increase or diminish the figures of the second term?

Ans. This column of ratios is calculated by dividing the area of the opening in square inches of the outlet at the overhanging lip by the area at the ground joint. Hence, if an area be taken for the ground-joint area which is less than the area used in the calculation the quotient will be somewhat greater. That is the only way in which I can express it.

Cross-int. 144. Do you mean by quotient the second term of your ratio?

Ans. I do.

Cross-int. 145. Why, in measuring the valves not made by Richardson, which you call Richardson valves in answer to Int. 46, did you subtract half the lift from the diameter at the top of the ground joint?

356 Ans. First, because those calculations were made by themselves. The measurements were small, close, and I wanted to have a strictly accurate result.

Cross-int. 146. How did it conduce to accuracy to make a factor by deducting one-half of an extreme vertical measurement, which varied in the blowing of the valve, from a constant horizontal measurement?

Ans. That was the very point where it was necessary to be accurate.

Cross-int. 147. How did it conduce to accuracy?

Ans. Because it was the only way by which the average circumference of the outlet from the ground joint could be determined.

Cross-int. 148. Having deducted this perpendicular factor from this horizontal factor, what next did you do in order to get the mean circumference of the opening?

Ans. The amount which I deducted was not a perpendicular factor.

Cross-int. 149. Was it not perpendicular to the line which you took for the diameter at the top of the ground joint?

Ans. It was not.

Cross-int. 150. At what angle did the valve lift, with relation to the line which you took as the diameter at the top of the ground joint?

Ans. Ninety degrees, or perpendicular.

Cross-int. 151. The length of that perpendicular line divided by 2 was what you substracted from the diameter, wasn't it?

Ans. It was.

Cross-int. 152. And having deducted half of a perpendicular length from the whole of a horizontal length, what did you do with the remainder to get the mean circumference?

Ans. I might say here that the method which I gave is a little defective, in this, where it says, "and substracted from that half the lift," I should have said, "an amount equal to half the lift." To get the mean circumference I multiplied by 3.1416.

Cross-int. 153. That gave you, then, a circumference which was located inside of the ground joint, half way between the two surfaces which had ceased to be a ground joint and equidistant be-

357 tween them and a distance equal to one-quarter of the height

of the lift inside of the edge of the bevel all the way round, didn't it?

Ans. No, sir; not entirely.

Cross-int. 154. In what other place, with relation to the outer edge of the bevel, would such a circumference have been located in any of the particulars mentioned in the last question?

Ans. This circumference is located midway in the length of a line drawn from the angle at top of ground joint at right angles to the ground face of the valve, and terminated by that face.

Cross-int. 155. And how does that location differ from the one described in cross-int. 153?

Ans. It differs in this, that the last question I understood and the other I didn't understand.

Cross-int. 156. What difference would it have made in your calculations if you had taken the circumference at the place at which steam entered the ground joint instead of the circumference at which steam left the ground joint in these so-called Richardson valves, considerable or otherwise?

Ans. Otherwise—that is, it would be a small difference, depending on the difference in measurements.

Cross-int. 157. Will you please take the certified copy of the Richardson patent and read to me from that patent anything which describes an operative relation between the area of opening in the ground joint and the area of opening at the passage leading from the chamber D to the open air, which renders, in your judgment, these calculations and measurements of yours in any way instructive to anybody except as gymnastics?

(Objected to, as this patent has been in contention in this suit and been the subject of a decision by the Supreme Court, under which this accounting is now going on, and any reading by this witness of what this patent says, unless with the opinion of the Supreme Court, who have construed this patent, before him to aid him in a just and proper interpretation of what it means would, on his part, be presumptuous, if not an act of temerity, and ought not to be permitted. Question admitted and objection saved.)

Ans. I find on the last page, "What I claim as my improvement and desire to secure by letters patent is a safety-valve with
358 the circular or annular flange or lip *c c* constructed in the manner or substantially in the manner shown, so as to operate as — for the purpose herein described."

This Richardson valve, Defendants' Exhibit Richardson Valve from Original Drawing and Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing, are constructed in the manner shown in the patent and drawing connected therewith, and they do operate precisely as and for the purpose described in said patent.

I make another quotation from the patent:

"The escape of the steam by means of this safety-valve is so certain and free that the pressure of the steam in the generator or

boiler will not increase beyond the point or degree at which the valve is set to blow off."

(Adjourned.)

JAN. 4, 1887.

Direct examination resumed:

Int. 158. Describe a gate valve such as you had upon the testing apparatus, so far as it provides an opening through it.

Ans. A gate valve has a sliding plate, which when pulled out to its fullest extent leaves a straight and unobstructed passage directly through.

Int. 159. Were the gate valves, which were below the safety-valves tested, wide open?

Ans. They were.

Int. 160. What was this boiler on which you made your tests used for?

Ans. For testing safety-valves made by the Crosby Steam Gage and Valve Company.

Int. 161. How large valves have you seen tested upon it, using a gate valve which you used?

Ans. Six inches diameter, marine valve.

Int. 162. On which gate valve were the large iron complainants' valves tested?

Ans. On the large gate valve, which I have described as permanently fixed to the boiler.

Int. 163. How did the opening of that gate valve compare with the openings of the safety-valves tested on it?

359 Ans. It was very much greater.

Int. 164. Where were the brass valves tested?

Ans. Tested upon a smaller gate valve connected with the lower gate valve. In the case of the very smallest valves there was still another valve between the upper gate valve and the lower gate valve, and there were also the necessary bushings used to reduce the diameters.

Int. 165. How were the gate valves connected?

Ans. By being placed one upon the other with nothing intervening.

Int. 166. Did anything obstruct the passage of the stream from the boiler to the valve tested at any time when under test?

Ans. No, sir.

Int. 167. Please read cross-int. 99 and state whether you wish to correct or change your answer.

Ans. What I meant to be understood was that the same large lower gate valve was always in its place, permanently fixed to the boiler, and upon this large gate valve the large safety-valves were placed. As the size of the valves grew smaller, smaller gate valves and connections were introduced above this lower gate valve, and the opening in the smallest gate valves when in use were always greater than that of the opening of the valve being tested.

Int. 168. As an engineer, have you been accustomed to fit safety-valves at their ground joints?

Ans. I have ground them with my own hands.

Int. 169. What is the method?

Ans. The method which I used to follow and which I still believe to be correct is to fit the valve by turning and filing and finally by grinding with sand or emery until a fair and perfect bearing was obtained between the whole conical surface of the valve and its seat. This grinding is accomplished by rotating the valve with the grinding material between its conical face and the corresponding face of the valve seat, the valve at the time being pressed to its place either by outside pressure or by its own weight.

Int. 170. Please state if the testing apparatus that you saw Mr. Burnett use in testing Defendants' Exhibit Complainants' Valves was the same that you used in testing the same valves.

Ans. It was the same.

360 Cross-examination resumed:

Cross-int. 171. It is your opinion, then, that in the ground joints of the bevel-seated valves tested by you the seat of the valve extended from the lower edge of the bevel to the upper edge of the bevel, is it?

Ans. The valves were all new. The valves which were made by the Crosby Gage Company I saw when they had been newly ground, and it is my belief such was the case.

Cross-int. 172. You tried a flat-seated valve called here "Defendants' Exhibit Waterman 1853 Patent." Do you know whether that valve bore on its seat so as to seal the flat ground joint at the edge of the main steamway?

Ans. This valve seems to bear a little hardest at the outer edge.

Testimony of William Burnett.

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Jan.* 4, 1887.

Int. 1. Please state your name, age, residence, and occupation.

Ans. William Burnett; sixty-one; New York city; consulting mechanical engineer.

Int. 2. You are the person of the same name who testified in this case at the rules?

Ans. Yes, sir.

Int. 3. Did you receive from William H. Harrison any safety-valves to be tested by you at a recent date?

Ans. Yes, sir.

Int. 4. Examine Defendants' Exhibits Richardson Valve, ¾ in., No. 104; Complainants' Valves, 1 in., No. 4692; 1¼ in., No. 889; 1½ in., No. 487; 2 in., No. 123; 2½ in., No. 148; 3 in., No. 188; 3½ in., No. 123, and 4 in., No. 130, and Complainants' Exhibit C, and state whether or not they are the ones so received by you.

Ans. they are.

361 Int. 5. When and where did you make any tests of these valves?

Ans. The tests were made on the 10th and 11th of December last, at the works of the Crosby Steam Gage and Valve Company, in Boston.

Int. 6. What was the condition and capacity of the steam-boiler upon which you made your tests, having in view the size and character of the valves to be tested?

Ans. I found it of sufficient capacity for the purpose of testing these valves.

Int. 7. In making the tests, at what pressures did you set the valves?

Ans. At the pressures stated on the tags attached by the manufacturer, or as I understood were so attached.

Int. 8. In the case of those complainants' valves not so tagged, at what pressures were they set?

Ans. At the pressures stamped upon their casings; the 2½-inch valve, being Complainants' Exhibit C, not stamped for any particular pressure, was tested at one hundred pounds.

Int. 9. At the tests made, whether or not you obtained in each case the lift of the valve?

Ans. I did.

Int. 10. Were these valves, at the time of and before the test, ready and in a condition to be attached for trial?

Ans. They were.

Int. 11. Whether or not you obtained from them by measurement the dimensions of those parts of the valves relating to the valve proper and valve body or bush; if so, when, before or after the trial?

Ans. The parts were measured very carefully after the trial was made.

Int. 12. Will you please give the result of the tests made by you of these valves, showing the lift of each valve, the amount of opening and closing in pounds pressure at which each valve opened and closed, the dimensions obtained by you of each valve, a computation derived from these dimensions showing the opening at the

362 ground joint and the opening at the lip of each valve and the ratio of such openings?

(Objected to as incompetent and irrelevant on any issue of this accounting, and on various grounds heretofore interposed to similar questions propounded to Mr. Harrison. Action of the master upon this objection is reserved to the draft and final reports, and all the rights of the parties respectively are also reserved.)

Ans. The items obtained by means of these tests, and which were acquired by very close measurement of the parts and calculations based upon such measurements and tests, were:

1. Diameter of steamway of each valve.
2. Diameter of top of ground joint.
3. Diameter of inside of lip.

4. Diameter of outside adjustable ring or valve seating.
5. Horizontal width of outlet at lip.
6. Mean diameter of opening at lip.
7. Lift of valve under steam.
8. Overlap of valve at lip.
9. Effective diameter at ground joint.
10. Effective diameter at lip.
11. Width of opening at ground joint.
12. Width of opening at lip.
13. Area of opening at ground joint.
14. Area of opening at lip.
15. Ratio of openings, ground joint to lip.
16. Pressure at which the valve opened under steam.
17. Pressure at which the valve closed with steam.
18. Loss of pressure in pounds.

The ratio of openings, ground joint to lip, I find to be in the 4-inch valve 1 to 2.12; in the 3½-inch valve, 1 to 2.30; in the 3-inch valve, 1 to 1.67; in the 2½-inch valve, 1 to 1.78; in the 2¼-inch valve, 1 to 2.11; in the 2-inch valve, 1 to 1.77; in the 1½-inch valve, 1 to 1.60; in the 1¼-inch valve, 1 to 1.76; in the 1-inch valve, 1 to 2.13; in the ¾-inch valve, 1 to 2.08.

I have all the data obtained and in tabular form, and now present it, to be entered, as part of my answer, in the record, as follows:

Nominal diameter of safety-valves.	4″	3 1-2″	3″	2 1-2″	2 1-4″	2″	1 1-2″	1 1-4″	1″	3-4″
1. Diameter of steamway	3.99	3.51	3.01	2.51	2.25	2.01	1.50	1.26	1	.75
2. " top of ground joint	4.21	3.72	3.25	2.69	2.55	2.18	1.65	1.38	1.10	.84
3. " inside of lip	5.66	4.92	4.26	3.47	3.28	2.73	2.14	1.85	1.44	1.11
4. " outside adjustable ring or valve seating	5.60	4.84	4.18	3.37	3.17	2.67	2.07	1.76	1.37	1.08
5. Horizontal width of outlet at lip	.03	.04	.04	.05	.055	.03	.035	.045	.035	.015
6. Mean diameter of opening at lip	5.63	4.88	4.22	3.42	3.225	2.70	2.105	1.805	1.405	1.095
7. Lift of valve	.06	.08	.08	.08	.05	.05	.07	.05	.03	.03
8. Overlap of valve at lip	.000	—.01	.02	.02	.03	.01	.02	.035	.03	.000
9. Effective diameter at ground joint	4.18	3.68	3.21	2.65	2.525	2.155	1.615	1.355	1.085	.825
10. Effective diameter at lip	5.63	4.88	4.22	3.42	3.225	2.70	2.105	1.805	1.405	1.095
11. Width of opening at ground joint	.04242	.05656	.05656	.05656	.03535	.02535	.04949	.03535	.02121	.02121
12. Width of opening at lip	.06708	.0984	.0721	.0781	.0585	.05	.06103	.0474	.035	.0335
13. Area of opening at ground joint	.5569	.6538	.5701	.4705	.2803	.2393	.2510	.1504	.0722	.0549
14. Area of opening at lip	1.1859	1.5084	.9553	.8387	.5926	.4240	.4035	.2687	.1544	.1142
15. Ratio of openings: Ground joint to lip	1.—2.12	1.—2.30	1.—1.67	1.—1.78	1.—2.11	1.—1.77	1.—1.60	1.—1.76	1.—2.13	1.—2.08
Tag No. — or stamped	130	123	188	148	*	123	487	889	4692	104
16. Trial under steam: Valve opened at	80	80	80	80	100	80	100	100	100	100
17. Valve closed at	76	76.5	76.5	76.75	98	78	94.75	94	96.5	96.5
18. With loss of pressure in pounds	4	3.5	3.5	3.25	2	2	5.25	6	3.5	3.5

* Complainants' Exhibit C.

364 Int. 13. What is to be understood by the statement "effective diameter at ground joint"?

Ans. It is that diameter which represents the true opening by the ground joint as found by subtracting from the upper diameter of the ground joint one-half the lift of the valve.

Int. 14. In statement "8, overlap of valve at lip," where the sign minus occurs before the figures, how does that indicate the location of the lip in relation to extended valve seat?

Ans. In general, the amount of overlap is expressed with reference to the valve seating as exceeding that, and, from the introduction of this minus sign, it is intended to express that there is not only no overlap, but less than no lap by the amount expressed in the figures.

Int. 15. Considered upon the horizontal plane of the extended valve seat, where does the lower edge of lip then come?

Ans. At some distance above the edge of the seating.

Int. 16. How did you obtain the "width of opening at ground joint" as found in statement 11?

Ans. Multiplied the lift of the valve by the sine of the angle of the seat, which is .707.

Int. 17. At what stage in the operation of the valve do the statements 9, 10, 11, 12, 13, 14, and 15 indicate?

Ans. When the valve is fully lifted under steam pressure.

Int. 18. This full lift is found in the case of each valve in statement 7, is it not?

Ans. Yes, sir.

Int. 19. When you obtained the diameters of the valves at the valve seating, as shown in statement 4, whether or not there had been any change of what is called there "the adjustable ring" from its condition at the time of the test?

Ans. The measurements were made after the tests; there was no change from time of testing to the time of measuring them.

Int. 20. Have you read the opinion of the Supreme Court in this case, and do you understand the mechanical description therein by the Supreme Court of the Richardson valve?

Ans. I have and do.

Int. 21. Please compare each and all of the valves, and generally, if it can be so done, which you tested with the safety-valve
365 described in the Richardson patent of 1866, according to the mechanical description given by the Supreme Court of the Richardson invention, limiting your comparison to that portion of the valves tested embracing the valve proper, the body, and the attachments.

Ans. All the valves which I tested in their essential features have the general appearance of conformity to the Richardson valve, as described in the decision of the Supreme Court, while in fact there are wide and essential differences, and especially in regard to the comparative size of openings required, as between the ground seat of the valve and the strictured orifice at the lip of the valve. The court say:

"Richardson is, therefore, entitled to cover, by the claim of his

patent of 1866, under the language, 'a safety-valve with the circular or angular flange or lip *c c*, constructed in the manner or substantially in the manner shown, so as to operate as and for the purpose herein described,' a valve in which are combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air, the orifice being proportional to the strength of the spring, as directed."

And regarding the size of the stricture required the court say:

"In the Richardson valve all the steam which escapes into the open air escapes from the huddling chamber *through a stricture which is smaller than the aperture at the ground joint.*

The italics are mine.

Richardson has very fully described the necessity for this arrangement and proportion of openings in the production of a safety-valve to operate as described by him.

In the third paragraph of his patent of 1869 he describes the features of his improved safety-valve patented in 1866 as follows:

"My said invention (1869) relates to improvements in the invention described in letters patent granted to me and bearing date the twenty-fifth day of September, 1866, which said patented invention relates to a means for providing a more free escape for the steam than could be obtained by safety-valves as constructed prior thereto, and to insure the keeping of the valve open until the pressure
366 of the steam in the boiler or generator falls below the pressure which was required to open it, the said means so patented consisting in forming the valve with a surface outside the ground joint for the escaping steam to act against, the said surface being surrounded by a projecting or overlapping lip, rim, or flange, leaving a narrow space for the escape of steam when the valve is opened, but which, although of greater diameter than the value seat by reason of said lap, presents a *less area of opening* for the escape of steam *than is produced at the valve seat*, so that the steam which escapes through the area between the valve [and seat?] shall exert pressure against the said surrounding surface, and thereby not only open the valve completely, but hold it up until the pressure of the steam in the boiler falls below the pressure by which the valve was opened."

The italics in this quotation are also mine.

At a later part of his specification Richardson rehearses this necessity of making the stricture through which the steam escapes from the huddling chamber into the open air of *a less area* than the opening produced at the valve seat. He says:

"If the projecting rim *q* were *in the same plane* with the lower edge of the flange *n*, the diameter of these parts being greater than that of the valve seat, on the lifting of the valve and cap the area of the opening between the flange *n* of the cap and the projecting rim *q* would be greater than the area of the opening between the valve and its seat just in proportion as the diameter of the one is greater than the other, and the steam escaping from the valve would *pass unchecked* between the flange *n* and rim *q*, and *would not exert any force* against the surface of the annular space *o*; but, as the rim *q* extends

above the lower edge of the flange *n* of the cap plate, it follows that *the aperture between the valve and its seat, by the lifting of the valve, is always greater* than the aperture between the flange *n* and the rim *q*, and hence the escaping steam, by its elastic force, will act against the surface of the annular space *o* to assist in lifting and holding up the valve until the pressure in the boiler or generator falls below the pressure by which the valve was first opened."

I have italicized a part of this quotation.

The court say:

"What was needed was a narrow stricture to hold back the escaping steam and receive its expansive force inside of the lip, and thus aid the direct pressure of the steam from the boiler in lifting the valve against the increasing tension of the spring, with the result that, after only a small but a sufficient reduction in the boiler pressure, the compressed spring would, by its very compression, obtain the mastery and close the valve quickly. This problem was
367 solved by Richardson, and never before. His patent of 1869 describes the arrangement and operation of the whole apparatus with the adjustable ring, thus: When the pressure of the steam lifts the valve, the steam acts against the surface of an annular space between the bevel of the valve seat and the downward projecting flange of the cap plate to assist in holding up the valve against the increasing resistance of the spring. The aperture between the valve and its seat *is always greater* than that between the flange and the upward projecting rim, and thus the steam in the annular space assists in holding up the valve till the boiler pressure falls below that at which the valve opened."

The court construe the claim of Richardson's patent of 1869 as a "combination with the surface of the huddling chamber and a strictured orifice, of a screw-ring to be moved up and down to obstruct such orifice more or less, in the manner described." From this I understand that the strictured orifice is still subject to the conditions which attach to it regarding the comparative area of opening produced at the ground joint by the opening of the valve, as described in the specification. As appears from the drawing, Fig. 1 and its description, the overlapping of the parts *q* and *n* is still illustrated, and it is stated in the specification that the device would not work successfuly unless an overlap was employed as represented. The screw-ring is to regulate or adjust the area of the passage for the escape of steam pressure within the huddling chamber.

Int. 22. In view of the mechanical description which you have just given, how do the safety-valves tested by you compare with the safety-valve of the Richardson patent, having reference to the area of the opening at the ground joint and the outlet from the additional surface upon which the steam acts?

Ans. The court in their decision have expressed their opinion on that subject, in view of what Richardson did, that the outlet from the huddling chamber must always be smaller than the opening at the ground joint of the valve through which the steam is induced into the huddling chamber, and this is treated as an essential feature of the construction, and entirely necessary to the proper operation

of the Richardson safety-valve as described by him and as understood by the court. All the valves which I examined and tested, said to be issued by the Consolidated Safety Valve Company, had the opening at the orifice through which the steam is dis-
368 charged from the huddling chamber to the open air much larger than the opening produced at the ground joint when the valve was open, the ratio of opening (ground joint to lip) being generally as much as 1 to 2.

Int. 23. In what sense do you use the words "huddling chamber," with reference to the valves tested, technically as defined by the Supreme Court, or otherwise?

(Adjourned.)

JAN. 5, 1887.

Ans. In reference to the valves tested by me, I use the words "huddling chamber" in the popular sense—not in the technical sense as defined by the Supreme Court, which requires that the exit opening from the "huddling chamber" shall always be *smaller* than the opening produced at the ground joint when the valve is open, while in the valves tested by me the exit opening from the "huddling chamber" is always *larger* than the opening produced at the ground joint, as above, varying from 60 to 130 per cent.

Int. 24. What has been your experience with what are called "pop" valves, meaning valves having an additional surface to be acted upon by the steam when in operation to compensate for the increasing power of a direct-acting spring?

Ans. I have seen a great many of these valves in operation and observed their working and have made tests as to their manner of working.

Int. 25. You were at one time supervising inspector general of steam vessels of the United States. When was that?

Ans. I was connected with that service for more than twenty years; for about eighteen years supervising inspector of steam vessels, part of the time for New England and otherwise for the Pacific coast of the United States, and supervising inspector general for about two years and a half, residence at Washington.

Int. 26. During your service as inspector general, whether or not you made tests of safety-valves under Government direction; if so, when and where?

Ans. I did, in 1875, at the Washington navy yard. I tested about forty-five valves of different constructions. I refer to my testimony in this case, pages 256 to 260 of the Record, as showing what these tests were and the results obtained.

369 Int. 27. Were these tests and their results published by the United States Government?

Ans. They were, in September, 1875.

Int. 28. Who supervised the compiling and the making of the report of those tests?

Ans. I was chairman of the committee who made the report and directed its arrangement.

Int. 29. At the time of its publication had you retired from the service?

Ans. Yes, sir; I had. The report was made to the board in 1876, while I was president, and was printed afterwards, in 1877, by the new board.

Int. 30. Please examine the printed pamphlet now handed you and state whether or not that is the report referred to in your last answer.

Ans. This is a copy of the report.

(Report shown witness is marked for identification "Government Safety-Valve Tests, J. G. S., master.")

Int. 31. Will a safety-valve made in accordance with the mechanical description of the Richardson valve, as given by the Supreme Court in its opinion in this cause, operate within limits of loss such as, in your judgment and experience with safety-valves, you would deem prudent?

(Objected to for reasons formerly given and as manifestly improper. Reserved as before.)

Ans. It would not.

Int. 32. What, in your judgment and knowledge of the use of safety-valves, would be a prudent limit of loss?

Ans. Three to five pounds pressure in a hundred.

Int. 33. Do what are called pop safety-valves generally work within such limits?

Ans. Yes, sir; according to my observation.

Int. 34. Assuming that a safety-valve made like the Richardson valve, according to the mechanical description of the court of it, should lose from twenty to thirty pounds in a hundred, while it might operate so that the steam pressure never would rise above that at which it is set, would such a valve have any worth or value as a safety-valve for ordinary use on steam-boilers?

370 Ans. No, sir.

Int. 35. Will you please give your reasons for your opinion just expressed?

Ans. Because, in the reduction of twenty or thirty per cent. in the steam by blowing off, the power of the boiler would be destroyed just to that extent for the time being, and this pressure would have to be recovered by the expenditure of a large amount of fuel and loss of time and labor before the boiler could be brought back into its normal working condition, while such a reduction of pressure might unfit the boiler for the time to perform the duty usually required of it and so suspend its operation as a motor.

Int. 36. However effective a safety-valve, such as is mentioned in Int. 34, may be to prevent the rise or accumulation of steam above the pressure at which it is set, has such a valve, if in its operation great loss of steam follows, a value as a safety appliance in the commercial world?

Ans. None whatever.

Int. 37. In the record in this case, on page 391, I find, in the deposition of Thomas Adams, that George W. Richardson "proportioned the head to valve as about 1 to 1. He * * * made the lip of the valve dip a base $\frac{1}{16}$" below the plane of the valve seating and made the stricture orifice about $\frac{1}{16}$" in width. It is these proportions of outer orifice to seating orifice of valve by which a vacuum is sucked in the centre of the current of the outflowing steam, the outer orifice being so proportioned that it will just carry away all the steam the seating orifice can pour into the chamber between the orifices, by which, with a reduction of one pound pressure in the boiler, the vacuum acting in the current of the outflowing stream enables the valve automatically to return to its seat." Will a valve made in accordance with these directions be in accordance with the mechanical description of the Richardson valve as given by the Supreme Court?

Ans. No, sir.

Int. 38. Please give your reasons for that opinion just expressed, and at the same time consider the illustrations of the Adams valves as shown in the record.

Ans. My reason is that the strictured orifice at the lip of
371 the valve will be found, comparatively with the opening produced at the ground joint, altogether too large, in view of that decision. All the Adams valves, as shown in the record, do not conform to the requirements of the decision of the court for the same reason, namely, that, in working, the opening at the lip will always be greater than that produced at the ground joint.

Cross-examination by T. W. CLARKE, Esq., of counsel for the complainants:

Cross-int. 39. Please describe the length, calibre, construction, and details of the boiler referred to in answer to Int. 6, and — whether this boiler was the same used in all your experiments.

Ans. It was a vertical, tubular boiler, about thirty-eight inches diameter and about ten feet high. The number of tubes or size of tubes I don't know, and did not examine. I considered the boiler sufficient for the tests made, for the reason that, in testing the largest valves, the water of the boiler was not raised to show itself at the valve when raised to its highest working opening. This is all that could be desired, and showed that the pressure was not reduced so rapidly by the blowing of the valve as to interfere with its proper action. There were three gate valves on the top of this boiler, all but one of which might be removed for the testing of large valves, and in this case the only valve retained on the boiler to test the 4-in. and 3½-in. valves was a valve having through it a direct opening or six inches diameter. In testing the 3 in. down to 2 in., a 2½-in. gate valve was used on the top of the first, and for the 1½-in. valve and under a 1½ in. gate valve was used. These gate valves furnish a clear and direct opening equal to their diameter as expressed. All the valves tested were fully supplied with steam.

Cross-int. 40. With regard to the valves, Defendants' Exhibits Complainants' Valves, 4 in., No. 130; 3½ in., No. 123; 3 in., No. 188;

2½ in., No. 148, and 3 in., No. 123, I notice that you report in your table that they opened at 80 lbs. each. How did you obtain this opening pressure of 80 lbs., from a steam-gauge or otherwise; and, if from a steam-gauge, to what part of the testing apparatus was that steam-gauge connected?

Ans. It was from a steam-gauge, and to the best of my
372 recollection attached to the boiler direct. It was the gauge used for setting valves every day by the company and observing their working.

Cross-int. 41. Mr. Harrison found that the 2-in. valve popped at 78 to 76 and closed at 74, while you find that it popped at 80 and closed at 78; he also found that the 2½-in. valve popped at 76½ and closed at 74½, while you find that it popped at 80 and closed at 76.75; Mr. Harrison found that the 3-in. valve popped at 77½ and closed at 74½, and you find it popped at 80 and closed at 76½; Mr. Harrison found the 3½-in. valve popped at 76 to 77½ and closed at 73½, while you find it popped at 80 and closed at 76½; Mr. Harrison found that the 4-in. valve popped at 77½ to 78 and closed at 74, while you find it popped at 80 and closed at 76; Mr. Harrison found that defendants' valve, Exhibit 14, popped at 100 and closed at 99½, and that Complainants' Exhibit C popped at 100 and closed at 97, and you find that a 2¼-in. valve, marked Complainants' Exhibit C, popped at 100 and closed at 98. Mr. Harrison says that he carefully tested and compared the gauges with which he made his observation with standard gauges. Did you make any comparison of the gauges with standard gauges. And, if so, please account for the discrepancy between your observations and those of Mr. Harrison, if you can.

Ans. I did not make any such comparison with standard gauges; I thought this was one put up there for the purpose. I can only account for the discrepancies between Mr. Harrison's report and my own by understanding from Mr. Harrison that his tests were made before the seals were removed from the valves for the purpose of examining, while the valves when tested by me were set to blow off at the pressure marked upon the tags, and the spring closed and opened so that they would pop exactly at the figures marked. It will be seen by the tables that about the same reduction is made, whether the valves were set to blow as in Mr. Harrison's table or in mine.

Cross-int. 42. You remember, then, to have adjusted the spring of these valves so that they should blow at the proper and tagged pressure, do you?

Ans. That is true. In accounting for this discrepancy, it should be understood that between the time of Mr. Harrison's tests and my
own the valves had been taken apart with a view of getting
373 the exact dimensions of the different parts. They were afterwards put together carefully as they were found, as I understand; and on the occasion of my tests the valves were frequently popped at the pressure stated by Mr. Harrison in his table, but I considered the better way for my tests to set the valves to blow at the pressure marked on the tags by the manufacturer.

Cross-int. 43. You talk about the effective diameter at the ground joint. Do you mean to say, when you use that phrase, that any other diameter of the ground joint than what you are pleased to call the "effective diameter" is an ineffective diameter?

Ans. No, sir. I considered that the proper diameter from which to compute the working diameter of the valve—that is, if the valve opened, leaving its ground seat to some extent, the flow of steam would be through the opening so made at its centre rather than at either periphery.

Cross-int. 44. When engineers compare the diameter of a safety-valve to its lift, as a matter of practical regulation do they compare the outside diameter of a bevelled ground joint, or any less diameter of the bevelled ground joint than the smallest diameter of the bevelled ground joint, with the lift, or do they compare the diameter of the steamway with the bevelled ground joint and say that a lift one-quarter of the area of the steamway is the lift which will give the maximum delivery orifice to the valve?

Ans. That is the maximum orifice that can be made through the valve opening, the lift being one-quarter of the diameter of the steamway; but this is not the operation of any valve practically, as no valve will lift from its seat one-quarter of its smallest diameter, but only very much less than this.

Cross-int. 45. On page 7 of your book, "Government Safety-Valve Tests," there appear to have been certain dimensions taken of some safety-valves, and those dimensions have in them two factors, diameter of opening and diameter of valves, in all of which, except the last, the diameter of valves is larger than the diameter of opening. What does the diameter of opening refer to in that table, and what does the diameter of valve refer to?

Ans. The diameter of opening and the diameter of valve indicate the diameter of steamway.

374 Cross-int. 46. How does it happen, with regard to top of ground joint in the 30-inch valve, that the diameter of the top of the ground joint is smaller than the diameter of the steamway, when the width of the valve face was .15 of an inch? Was that a back-seated valve?

Ans. It is manifestly a typographical error.

Cross-int. 47. In the various illustrations and tables given in this pamphlet, I notice that there is mentioned in several cases an area of opening, an area exposed, and a lift. Will you please explain the sense in which those words are used in this pamphlet?

Ans. "Area of opening" means the area of the opening covered by the valve, in square inches—that is, the area of the steamway. "Lift" has reference to the vertical height to which the valve rose from its seat, expressed in parts of an inch. "Area exposed" is effective area.

Cross-int. 48. On the thirteenth page of your pamphlet I find several times repeated the words "effective areas," and a note saying, "Effective area expresses the opening due the lift of the valve; area that due the diameter." If, with regard to the various valves taken in that table, you multiply the lift of the valve by the proper

factors to give the result stated in table No. 1, would one of those factors be the diameter of the valve under consideration at the top of the ground joint or across the steamway or at some intermediate point between the steamway and the top of the ground joint? And in this behalf please give me the factors of those various calculations other than the one already given in the table, the lift of the valve.

(Adjourned.)

JAN. 6, 1887.

Ans. It might be at some intermediate point between the bottom and top of the ground joint. That would depend upon the lift of the valve. The factors are the diameter of the valve at a point determined by the lift, the constant 3.1416 being employed to obtain the circumference of that diameter, and the natural sine of the angle of the valve seat from the axis of the valve spindle, the natural sine being for this angle (45°) .71, as used in the tables given in the pamphlet.

Cross-int. 49. What does the diameter given in the left-hand column of table 1 refer to, the diameter at the bottom or at the top of the ground joint?

375 Ans. The diameter at the bottom of the ground joint.

Cross-int. 50. This rule is expressed on page 18 of your pamphlet, is it not?

Ans. Yes, sir.

Cross-int. 51. Now the difference between the two rules, namely, the one that you seem to have worked on in your pamphlet and the one you worked on in making the table which you have introduced in evidence, seems to be this: that in the pamphlet, for a bevelled-seated valve you added one-half the lift to the diameter of the steamway and then performed your multiplication, while in the table that you prepared for this hearing you subtracted from the diameter at the top of the ground joint one-half the lift and then performed your multiplication. What reason did you have for changing the rule for calculating effective areas which you made fashionable and standard in 1877 for this new rule you have adopted in this case?

Ans. My reasons were that I found this new rule being worked with and understood that it was introduced into the case or used by Mr. Hoadley in computing the diameter of the valves. I was also influenced, in view of the very narrow ground seats employed in such valves, by the fact that it made but little difference, if any, sometimes not any, whether the measurement was taken from the top with half the lift subtracted or from the bottom with half the lift added; in fact, the measurement from the bottom of the ground joint could not be taken from that point at any considerable lift of the valve, as the measurement must be taken on a line perpendicular to the angle of the valve's face.

Cross-int. 52. In what you are pleased to call the mechanical description by the Supreme Court of the Richardson valve you consider, do you not, that the Supreme Court decided that under the Richardson patent of 1866 the directions given by Richardson required him to make a valve in which the strictured orifice leading

from the huddling chamber to the open air should be smaller than the aperture at the ground joint when the valve is lifted?

Ans. That is a description, in my view, of the valve patented by Richardson in 1866, as understood and set forth in that decision of the Supreme Court.

376 Cross-int. 53. It is because that relation between the area of opening at the ground joint when the valve is lifted and the area of opening at the stricture when the valve is lifted does not obtain in the complainants' valves tested by you that you say there are wide and essential differences between these valves tested by you and the Richardson valve as described in the opinion of the Supreme Court, isn't it?

Ans. Perhaps mainly so.

Cross-int. 54. What other wide and essential differences are there?

Ans. Some of these valves have no overlapping lip; some of them less than any. That is what I referred to by the words "other essential differences."

Cross-int. 55. When did you first begin to have experience with what are called pop valves, as referred to by you in answer to Int. 24?

Ans. I think in 1874 I first had something to do with valves of this kind; I can't be very certain as to the exact time.

Cross-int. 56. Prior to 1874 had you ever known of a practical commercial spring-loaded automatic valve which would let off any ordinary excess of steam without reducing the pressure in the boiler unduly; and, if so, when did you first learn of it?

Ans. I don't know that I did.

Cross-int. 57. Of whose make was the first pop valve which you became practically acquainted with as a machine?

Ans. I can't tell. I think it was Crosby's. In speaking of this valve by Crosby I do not refer to these patents of 1875.

Cross-int. 58. Have you any doubt that a safety-valve made according to your view of the mechanical description of the Richardson valve by the Supreme Court in their opinion in this case could by a simple alteration of the stricture be made to work within practical commercial limits?

Ans. I think it could if the stricture were made larger, if it provided a larger orifice for the escape of steam than that produced at the ground joint by the lift of the valve. In this respect, I might say that I have no opinion other than that of the Supreme Court.

377 Cross-int. 59. You have no doubt, have you, that when Richardson gave the instructions and definition which you have referred to, taken from the patent of Jan. 19, 1869, he also gave instruction in Fig. 4 of the drawing as it appears opposite page 20 of the Record, that where the head of the valve lapped upon these at adjacent to the point marked on the drawing e', and thereby made what has been termed in this case an overlap and a stricture, the space between the bottom of the overlap and the cylindrical part of the valve seat was to be wider at the edge of the lapping lip than

at the upper edge of the valve seat—in other words, that the inside of the lapping lip was bevelled outward in that drawing?

(Defendants object to the question unless the witness's attention is as well called to the text on page 23 of the Record, wherein, as appears on page 245 of the Record, the patentee amended his specification by adding after the words "valve seat *a'*," just before the claim, the following, "as set forth in my patent of September 25, 1866.")

Ans. I see nothing, either in the drawing, Fig. 4, of Richardson's patent of 1869 or in the description, from which I would understand that the space between the bottom of the overlap and the cylindrical part of the valve seat was to be wider at the edge of the lapping lip than at the upper edge of the valve seat; in other words, that the inside of the lapping lip was bevelled outward, or in any other manner formed than as shown and described in Figs. 3 and 4 of Richardson's patent of Sept. 25, 1866.

Cross-int. 60. Your testimony about the Richardson valve of 1886 has been based on the proposition that the sides of the overlap in the valve of the 1886 patent were necessarily parallel, has it not?

Ans. No, sir; not upon the proposition that they are necessarily parallel, but that they are so shown to be in the drawing.

Cross-int. 61. Your testimony has been based on the proposition that one of the sides of the overlap in the valve of the 1866 patent was necessarily vertical, has it not?

Ans. No; not upon the basis that one of the sides must be necessarily vertical, but that they are so represented.

Cross-int. 62. Your testimony has been based on the fact, has it not, that until the overlap of the Richardson valve of 1886 is surmounted the stricture of that valve of 1866 did not vary in size?

378 Ans. From the examination of that patent, I have had that understanding.

Cross-int. 63. If in the working of a valve it was discovered that the overlap caused too great a reduction, should you, as a mechanic, hesitate to reduce the overlap from any instructions that you find in the Richardson patent of 1886; and, if so, from what?

Ans. I would give more vent to the steam in some way, but how would be a matter of experiment, supposing I knew nothing previously of its construction and had no knowledge of other than common safety-valves.

Cross-int. 64. When you assumed to measure the comparative openings at the ground joint and at the valve seat in the valve of the Richardson patent of 1866, from which part of the line which marks the boundary of the metallic parts of the valve illustrated in the drawing of the Richardson patent of 1866 did you take your measures?

Ans. I don't think I measured any Richardson valve other than the ten valves I have stated as having been tested by me.

Cross-int. 65. In referring, as you did in answer to Int. 21, which required you to compare various valves of the Richardson patent of

1866, to the third paragraph of the Richardson patent 1869, did you consider that the patent of 1869 gave any information which could be used in considering the meaning of the Richardson patent of 1866 during the years 1867 or 1868?

(Objected to, because whatever may be the views of the witness as to the interval mentioned the question at issue here is of a period of time after 1869, and is considered under a decision of the Supreme Court, which has construed the patent of 1866, and refers the master to the decision in this case, and also the decision of the Supreme Court in the case of Complainants *v.* Kunkle, decided Nov. 15, 1886, and also the case between the same parties, 14 Fed. Rep., 732, cited by the court.)

Ans. I should say not, as the patent of 1869 didn't exist.

Cross-int. 66. In your observations in answer to that question about the patent of 1866 you made this reference to the patent of 1869: "As appears from the drawing, Fig. 1, and its description, the overlapping of the parts *q* and *n* is still illustrated." What
379 is the amount of the overlapping of those parts, and where do you measure it from and where do you measure it to, as regards the lines employed as boundaries of the metallic surfaces?

Ans. I cannot tell exactly what the overlap in the case referred to is, but it is considerable, and not less than is shown in the drawings of 1866. I measure from the top of the rim *q* to the bottom of the flange *n*, which projects downward from the cap plate *m*.

Cross-int. 67. Now will you please tell me which is the top of the rim *q* and which is the bottom of the flange *n*, with regard to the line which bounds these things in the drawing? Is the overlap measured by you or considered by you the most distant parts of those two lines, or the most adjacent part of those two lines, or something intermediate?

Ans. Differing from the parts showing the lap in the patent of 1866, which extends by a curved lip downward, enclosing the outer wall of the valve seating but leaving a stricture between those parts, in the present case the lip *n*, instead of inclosing the outer rim of the valve casing *q*, is brought within the said rim, and the two surfaces, the outer surface of the flange *n* and the inner surface of the rim *q*, are at such a distance apart as to form a strictured orifice between them. The flange *n* dips below the plane of the upper surface of the rim *q* so far as to produce considerable lapping of those parts, to such an extent as I have before testified.

The overlap as shown is the most distant part of those two lines when the valve is closed.

Cross-int. 68. Now, in considering what the amount of overlap is on a drawing, if the line bounding the parts represented were a hundredth of an inch wide and you took the most distant parts of the line to represent the boundary of the metal and it should happen that the draughtsman meant that the most adjacent parts of the two lines should be the boundary of the metal, it would make the difference of a fiftieth of an inch, wouldn't it, whether you took one edge or the other edge of these boundary lines?

Ans. Yes, sir.

380 *Testimony of Henry B. Renwick.*

Direct examination by B. F. THURSTON, Esq., of counsel for defendants:

BOSTON, *Jan.* 26, 1887.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Henry B. Renwick; sixty-nine; reside in the city of New York, and am by profession a civil and mechanical engineer.

Int. 2. State what has been your experience in mechanics, your familiarity with subjects of invention as an investigator, and particularly what has been your experience and study in respect to steam machinery, including steam-boilers and safety appliances for the same.

Ans. I have been engaged in mechanical pursuits since I left college, and for the last forty years have been familiar with subjects of invention and matters relating to patents, having had during that time, while principal examiner in the Patent Office, charge of all applications for steam-engines, boilers, safety-valves, etc., and was obliged then to investigate all that had been done in the art. I commenced the study of the steam-engine when I was fourteen years old, and have kept it up since; have designed and superintended the construction of large steam-engines, and was for about twelve years United States inspector of boilers for the port of New York, during which time I had to examine boilers and safety-valves almost daily.

Int. 3. What do you understand to be the construction of the Richardson valve as set forth by the Supreme Court in its opinion, referring also to the directions as to the comparative area of the "stricture" opening with the area of the opening at the ground joint, as set forth in the 1869 Richardson patent, as applicable to the structure described in the Richardson 1866 patent?

(Objected to because this witness was not called and did not testify in the principal case, and because no construction of the construction of the Supreme Court of the Richardson patent by this witness is admissible, and because the question is otherwise incompetent on the accounting.)

381 Ans. I have read the opinion of the Supreme Court, the Richardson patent of 1866, and the Richardson patent of 1869, and I understand from these that the Richardson valve of the 1866 patent is to be made with about the proportions of safety-valve proper and supplementary lifting area above the same shown in the drawings of said patent, and that the "stricture," which is the ultimate escape opening for the steam past the lip of the supplementary surface, is to be smaller in area than the area of opening at the ground joint, which is the opening between the safety-valve proper and its seat, this latter peculiarity of construction being set forth, not only in the opinion of the court, but also in the Richardson patent of 1869.

Int. 4. If a valve be made according to the Richardson drawings of 1869 and the directions of that patent, would it or would it not, in your opinion, be an economical valve, and give your reasons for any opinion you may express?

Ans. In my opinion, it would not, because the area of the "stricture" is too small in proportion to the area at the ground joint under such a proportion of safety-valve proper and supplementary area as is shown in the drawings of that patent. I have examined the measurements of the various parts of that valve, made by both the plaintiffs' and defendants' experts in the original case, and they agree substantially. The supplementary area and these two areas are nearly equal, while the area at the "stricture" is stated in the patent of 1869 and the opinion of the Supreme Court to be smaller than the area at the opening of the ground joint; consequently the pressure under the supplementary area after the valve has been lifted from its seat will be large, say, in round numbers, fifty or sixty pounds, more or less, as I have never made any experiments when the pressure on the main valve was one hundred. At any rate, it must be a pressure bearing a comparatively large proportion to the boiler pressure which is acting on the main valve, and consequently the valve cannot be shut while this pressure is acting both upon the main and supplementary valves until the boiler pressure has been considerably reduced. In this construction of valve, with the "stricture" smaller than the ground-joint opening, the whole orifice through which the steam escapes—that is, through the ground-joint opening, thence into the "huddling" chamber, as it has been called, and thence through the "stricture"—will be somewhat like the
382 escape of steam through a tube open at one end and smaller in area there than throughout the other part of the tube, exerting pressure on all parts of the tube, including the valve proper, and requiring the whole pressure thus exerted to be overcome by the spring before the valve can shut. If the "stricture" were larger in area than the ground joint, then the escape passage would be somewhat like a tube with the escape orifice larger than the diameter of the tube; consequently the pressure on the walls of the tube near the opening would be much less than at the narrowest point of the tube, and the spring would be sooner able to overcome the total pressure and shut the valve quickly.

Int. 5. In a table on page 363 of the evidence in this proceeding on accounting there appear statements concerning certain safety-valves there designated and previously described, showing their operation under steam, the dimensions of certain parts of them, and the ratio of openings at the ground joint and outlet or "stricture" of each of them. Now, assuming these statements to be correct, are said safety-valves made in accordance with the description of the valve in the Richardson patent of 1866, as the same is interpreted by Richardson in his patent of 1869 and as construed by the Supreme Court, as you understand the same?

Ans. I have examined the table referred to in the question, and it shows that in all the valves there tried the area of opening at the lip, which is the "stricture," and set forth in line fourteen of the table,

is much larger—in round numbers, about double the area of opening at the ground joint, which latter areas are printed on line thirteen of the table.

These measurements show conclusively that the valves enumerated in the question are not made in accordance with the Richardson patent of 1866 as interpreted by his patent of 1869 and the opinion of the Supreme Court. Their operation under steam would also prove the same fact to me, because I find that the valves enumerated in this table all shut when the boiler pressure had diminished only a few pounds, and were consequently economical, the diminution of the boiler pressure during the time which the valve was open and up to the time it closed or shut averaging from two to six pounds.

HENRY B. RENWICK.

383 *Testimony of George H. Crosby.*

(Resumed from page 249.)

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Feb.* 3, 1887.

Int. 19. Please give your name and state whether or not you have before testified in this proceeding.

Ans. George H. Crosby; I have.

Int. 20. How long have you been superintendent of the defendant company?

Ans. Since its organization.

Int. 21. As superintendent, did you have the control and direction of the making of the defendants' valves which have been accounted for in this proceeding?

Ans. I did.

Int. 22. How long have you been familiar with what are called "pop safety-valves" as found in use?

Ans. In the neighborhood of fifteen years.

Int. 23. Assuming the Crosby valve to be a safety-valve so organized that it has an initial area, an additional area, and a huddling chamber beneath this additional area, having discharge orifices leading from such huddling chamber, through the arms supporting such huddling chamber, to the open air, whose area is always smaller than the area of the opening at the ground joint over which the steam passes into the huddling chamber when the valve rises, would a valve so contrived have any advantage or saving accrue to it in use over the Defendants' Exhibit Complainants' Valves as designated, shown in dimensions, and the result of whose operations is found in a table given by William Burnett as a part of his answer to Int. 12, on page 363 of the printed Record of the accounting proceedings, these valves having the area of opening from the supplemental chamber at the lip always greater than the area of opening at the ground joint

Int. 4. If a valve be made according to the Richardson drawings of 1869 and the directions of that patent, would it or would it not, in your opinion, be an economical valve, and give your reasons for any opinion you may express?

Ans. In my opinion, it would not, because the area of the "stricture" is too small in proportion to the area at the ground joint under such a proportion of safety-valve proper and supplementary area as is shown in the drawings of that patent. I have examined the measurements of the various parts of that valve, made by both the plaintiffs' and defendants' experts in the original case, and they agree substantially. The supplementary area and these two areas are nearly equal, while the area at the "stricture" is stated in the patent of 1869 and the opinion of the Supreme Court to be smaller than the area at the opening of the ground joint; consequently the pressure under the supplementary area after the valve has been lifted from its seat will be large, say, in round numbers, fifty or sixty pounds, more or less, as I have never made any experiments when the pressure on the main valve was one hundred. At any rate, it must be a pressure bearing a comparatively large proportion to the boiler pressure which is acting on the main valve, and consequently the valve cannot be shut while this pressure is acting both upon the main and supplementary valves until the boiler pressure has been considerably reduced. In this construction of valve, with the "stricture" smaller than the ground-joint opening, the whole orifice through which the steam escapes—that is, through the ground-joint opening, thence into the "huddling" chamber, as it has been called, and thence through the "stricture"—will be somewhat like the
382 escape of steam through a tube open at one end and smaller in area there than throughout the other part of the tube, exerting pressure on all parts of the tube, including the valve proper, and requiring the whole pressure thus exerted to be overcome by the spring before the valve can shut. If the "stricture" were larger in area than the ground joint, then the escape passage would be somewhat like a tube with the escape orifice larger than the diameter of the tube; consequently the pressure on the walls of the tube near the opening would be much less than at the narrowest point of the tube, and the spring would be sooner able to overcome the total pressure and shut the valve quickly.

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Ans. I have examined the table referred to in the question, and it shows that in all the valves there tried the area of opening at the lip, which is the "stricture," and set forth in line fourteen of the table,

is much larger—in round numbers, about double the area of opening at the ground joint, which latter areas are printed on line thirteen of the table.

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HENRY B. RENWICK.

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(Resumed from page 249.)

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Feb.* 3, 1887.

Int. 19. Please give your name and state whether or not you have before testified in this proceeding.

Ans. George H. Crosby; I have.

Int. 20. How long have you been superintendent of the defendant company?

Ans. Since its organization.

Int. 21. As superintendent, did you have the control and direction of the making of the defendants' valves which have been accounted for in this proceeding?

Ans. I did.

Int. 22. How long have you been familiar with what are called "pop safety-valves" as found in use?

Ans. In the neighborhood of fifteen years.

Int. 23. Assuming the Crosby valve to be a safety-valve so organized that it has an initial area, an additional area, and a huddling chamber beneath this additional area, having discharge orifices leading from such huddling chamber, through the arms supporting such huddling chamber, to the open air, whose area is always smaller than the area of the opening at the ground joint over which the steam passes into the huddling chamber when the valve rises, would a valve so contrived have any advantage or saving accrue to it in use over the Defendants' Exhibit Complainants' Valves as designated, shown in dimensions, and the result of whose operations is found in a table given by William Burnett as a part of his answer to Int. 12, on page 363 of the printed Record of the accounting proceedings, these valves having the area of opening from the supplemental chamber at the lip always greater than the area of opening at the ground joint

Int. 4. If a valve be made according to the Richardson drawings of 1869 and the directions of that patent, would it or would it not, in your opinion, be an economical valve, and give your reasons for any opinion you may express?

Ans. In my opinion, it would not, because the area of the "stricture" is too small in proportion to the area at the ground joint under such a proportion of safety-valve proper and supplementary area as is shown in the drawings of that patent. I have examined the measurements of the various parts of that valve, made by both the plaintiffs' and defendants' experts in the original case, and they agree substantially. The supplementary area and these two areas are nearly equal, while the area at the "stricture" is stated in the patent of 1869 and the opinion of the Supreme Court to be smaller than the area at the opening of the ground joint; consequently the pressure under the supplementary area after the valve has been lifted from its seat will be large, say, in round numbers, fifty or sixty pounds, more or less, as I have never made any experiments when the pressure on the main valve was one hundred. At any rate, it must be a pressure bearing a comparatively large proportion to the boiler pressure which is acting on the main valve, and consequently the valve cannot be shut while this pressure is acting both upon the main and supplementary valves until the boiler pressure has been considerably reduced. In this construction of valve, with the "stricture" smaller than the ground-joint opening, the whole orifice through which the steam escapes—that is, through the ground-joint opening, thence into the "huddling" chamber, as it has been called, and thence through the "stricture"—will be somewhat like the
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Int. 5. In a table on page 363 of the evidence in this proceeding on accounting there appear statements concerning certain safety-valves there designated and previously described, showing their operation under steam, the dimensions of certain parts of them, and the ratio of openings at the ground joint and outlet or "stricture" of each of them. Now, assuming these statements to be correct, are said safety-valves made in accordance with the description of the valve in the Richardson patent of 1866, as the same is interpreted by Richardson in his patent of 1869 and as construed by the Supreme Court, as you understand the same?

Ans. I have examined the table referred to in the question, and it shows that in all the valves there tried the area of opening at the lip, which is the "stricture," and set forth in line fourteen of the table,

is much larger—in round numbers, about double the area of opening at the ground joint, which latter areas are printed on line thirteen of the table.

These measurements show conclusively that the valves enumerated in the question are not made in accordance with the Richardson patent of 1866 as interpreted by his patent of 1869 and the opinion of the Supreme Court. Their operation under steam would also prove the same fact to me, because I find that the valves enumerated in this table all shut when the boiler pressure had diminished only a few pounds, and were consequently economical, the diminution of the boiler pressure during the time which the valve was open and up to the time it closed or shut averaging from two to six pounds.

HENRY B. RENWICK.

383 *Testimony of George H. Crosby.*

(Resumed from page 249.)

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Feb.* 3, 1887.

Int. 19. Please give your name and state whether or not you have before testified in this proceeding.

Ans. George H. Crosby; I have.

Int. 20. How long have you been superintendent of the defendant company?

Ans. Since its organization.

Int. 21. As superintendent, did you have the control and direction of the making of the defendants' valves which have been accounted for in this proceeding?

Ans. I did.

Int. 22. How long have you been familiar with what are called "pop safety-valves" as found in use?

Ans. In the neighborhood of fifteen years.

Int. 23. Assuming the Crosby valve to be a safety-valve so organized that it has an initial area, an additional area, and a huddling chamber beneath this additional area, having discharge orifices leading from such huddling chamber, through the arms supporting such huddling chamber, to the open air, whose area is always smaller than the area of the opening at the ground joint over which the steam passes into the huddling chamber when the valve rises, would a valve so contrived have any advantage or saving accrue to it in use over the Defendants' Exhibit Complainants' Valves as designated, shown in dimensions, and the result of whose operations is found in a table given by William Burnett as a part of his answer to Int. 12, on page 363 of the printed Record of the accounting proceedings, these valves having the area of opening from the supplemental chamber at the lip always greater than the area of opening at the ground joint

when open, assuming also that the statements of the table are correct?

384 Ans. Understanding, by the conditions of the question applicable to the Crosby valve, that the huddling chamber referred to is the supplemental chamber at the centre of the valve, the discharge orifices are the holes or passages in the arms radiating from the central chamber and leading to the open air, and the ground joint is the inner ground joint at the circumference of this central chamber, such a valve, unless it had a large outlet, independent of the parts named in the question, through which the steam from a boiler to which it might be attached could freely pass to give relief to the boiler, would be substantially worthless as a safety-valve, although it might be an operative one; but the Crosby valve has such an outlet at the outer circumference of the initial area when the valve rises to blow, which is unobstructed and free to allow the steam to go into the open air and relieve the boiler by reducing the pressure from two to more pounds, as may be desired. The Crosby valve thus made is a prudent one in its operations. According to the statements of loss, when in use, of the Defendants' Exhibit Complainants' Valve shown in the table inquired about, these are also prudent safety-valves for use, and, comparing them with the Crosby valve last referred to, I do not see that there would be any difference between them as prudent operating valves, so that any greater advantage would accrue to one over the other.

Int. 24. Did the defendants' valves accounted for have an outlet at the circumference or the initial area, such as you have spoken of?

Ans. They did.

Int. 25. When information of the decision of the Supreme Court in this case reached you, what changes, if any, did you make in the Crosby valves such as made by the defendants? And, if so, please examine Defendants' Exhibit Crosby Valve, 1½ in., 1885, J. G. S., master, and state in what way it illustrates the change made.

Ans. I removed the screwed rim encircling the orifice and made the orifice smaller. This exhibit referred to corresponds to the valve made, in the particulars therein named, at once after such decision was made known to me.

Int. 26. How soon after the decision did this change take place?

Ans. Immediately. The orifices spoken of correspond now to such as are shown in letters patent granted to me Jan. 26, 1875,

385 No. 159,157, and mentioned in the specification. This is a similar valve in the principle involved, and the combined area of the discharge outlets is mentioned as "*preferably* less than the area of the opening into the chamber closed by the supplemental valve;" and, further, "this arrangement can be effected in various ways;" and, further, "the above-described arrangement renders it feasible to vary the reduction of the number of pounds pressure effected by the blowing off of the valve without the removal of any part from the boiler, and even while the valve is under pressure; and, further, the valve can be immediately adjusted from working properly at a high pressure to working properly at a low

pressure, and *vice versa*." The letters patent are found on page 98 of the Record at the rules.

Int. 27. In the valve just described, in addition to the parts mentioned in the specification, is there any outlet other than that from the orifices described by you?

Ans. There is. It is the orifice made when the main valve is opened, and corresponds to the opening at the outer circumference of the Crosby valve, as made since the decision, and this exhibit last referred to represents it.

Int. 28. Now, how do the valves made, as just described, compare to the valves accounted for by the defendants as to the degree of loss of steam pressure produced in operation and in use?

Ans. Favorably. They work the same in regard to loss of steam.

Int. 29. Have you been accustomed to make drawings and to construct machines or other things from drawings?

Ans. I have.

Int. 30. Please compare the valve to be handed you, showing a cross-section of its parts, with a drawing opposite page 86 of the "Transcript of Record, Supreme Court of the U. S., Oct. T., 1884, No. 19, The Consolidated Safety Valve Co., appellant, *v.* Erastus B. Kunkle," which drawing is entitled "Complainant's Exhibit Kunkle C[3]," and state what difference, if any, there is between the valve handed you, as shown in the cross-section of its ground joint, chamber, flange, and ring, and the corresponding parts as shown in the drawing.

(Objected to because it appears by the stamp on the valve
386 and also from the book produced and shown to the witness, on pages 70 to 78, inclusive, that the valves of this description were not open to manufacture by the defendants during the period of this accounting, and therefore any evidence upon them is irrelevant and incompetent.)

Ans. I see no difference.

Cross-examination by T. W. CLARKE, Esq., of counsel for complainants:

Cross-int. 31. What was the first pop safety-valve you were first acquainted with as an article of commerce?

Ans. One made by E. H. Ashcroft.

Cross-int. 32. That valve made by Ashcroft was quite similar in appearance to the valve marked "Defendants' Exhibit 14," except that, instead of a movable screw-ring upon its exterior, the place now occupied by the screw-ring was continuous with the other part of the valve proper?

Ans. It was, as near as I can recollect, as I was not engaged in the manufacture and had not any particular interest in its parts as made and put together and its working qualities.

GEO. H. CROSBY.

BOSTON, *Feb.* 9, 1887.

Defendants produce and put in evidence a drawing made by William H. Harrison in response to Int. 24 to him (Record, page 328), and the same is marked "Harrison Drawing Defendants' Exhibit Webster Valve, with flange resting on top of valve, J. G. S., master."

Defendants also put in evidence the following valves, marked for identification Nov. 2 and 3, 1886, "Crosby Farm Engine Valve, 1 in., J. G. S., master," "Crosby Valve for Farm Engines, 1¼ in., J. G. S., master," and "Crosby Valve, 1½ in., J. G. S., master;" also report, marked for identification (Int. 30 to William Burnett, Record, page 369) "Government Safety Valve Tests, J. G. S., master."

Defendants also put in evidence a certified copy of Transcript of Record, Supreme Court of the U. S., in Consolidated Safety Valve Company *v.* Erastus B. Kunkle, and same is marked "Trans-
387 cript of Record in Kunkle Case, J. G. S., master." (See Record, page 385, Int. 30.)

Defendants also put in evidence the valve shown witness George H. Crosby in connection with Int. 30 to him (Record, page 385), and same is marked "Defendants' Exhibit Kunkle Valve, J. G. S., master."

(Mr. Clarke objects to all these exhibits as incompetent and irrelevant on any issue of this accounting, and particularly as changing the issues that were made in the principal case passed upon by the Supreme Court.)

The defendants call the master's attention to the following citations from the record of this case at the rules as applying particularly to the proof of matters of substance duly set forth in their discharge:

1. Assignment of G. W. Richardson & Co. to Collis P. Huntington. (Record, page 38.)
2. Deposition of G. H. Crosby. (Record, page 318.)
3. Deposition of Albert C. Meady. (Record, page 326.)
4. Certificate of incorporation of complainant company. (Record, page 440.)
5. Assignment of G. W. Richardson & Co. to complainant company. (Record, page 45.)
6. Int. 46 and answer in deposition of Wm. Burnett. (Record, page 270.)

Evidence for Complainants in Reply.

Testimony of Charles W. Forbes.

Direct examination by T. W. CLARKE, Esq., of counsel for complainants:

BOSTON, *May* 5, 1887.

Int. 1. Were you sworn, and did you testify in the principal case?
Ans. I was, and did.

Int. 2. Have you recently made some additional experi-
388 ments with and investigations of new models purporting to have been introduced before the master since this decree?

Ans. I have.

Int. 3. Among the models introduced was a model marked "Defendants' Exhibit Richardson Valve from Original Drawing, J. G. S., master," which I now hand you and which purported to have been tried with two springs, one of which is upon the exhibit and is marked "Spring for Richardson Valve, of No. 6 Wire, J. G. S., master," and the other of which is marked "Spring for Richardson Valve, of No. 7 Wire, J. G. S., master." Did you experiment with that valve and with those springs?

Ans. I did.

Int. 4. Have you read and do you understand the examination of Mr. Hoadley and Mr. Harrison concerning the experiments made by them with said valve and springs just shown you, and did you read and understand those examinations before making your experiments?

Ans. I have read the examinations of Mr. Hoadley and Mr. Harrison and understand the same. I read such examinations and understood them before I made my experiments.

Int. 5. With that valve and those springs did you get any results materially differing from the results as stated by Messrs. Hoadley and Harrison?

Ans. I did not; I obtained the same results.

Int. 6. Did you have made from substantially the same castings from which the valve just shown you was made other valves substantially like the valve in the exhibit shown you, and did you try them unaltered, with the same appliances and the same springs?

Ans. I did. I caused to be made a valve precisely like the exhibit referred to and tried the same with the same springs and appliances attached to the exhibit referred to in the question and found the operation of the valve to be the same as said exhibit, as testified to by Mr. Hoadley.

Int. 7. Please look at the document now shown you, purporting to be a copy of the Richardson letters patent of Sept. 25, 1866, No. 58294, under the certificate of Elisha Foote, dated Sept. 8, 1868, and say whether or not that document was in your possession
389 and consulted by you during the time of making the experiments with the valves you have referred to.

Ans. I have examined it, and it is the same that was in my possession at the time mentioned, and which I consulted at that time.

Int. 8. Have you examined the original drawings of the Richardson patent of Sept. 25, 1866, on file in the Patent Office, so as to be able to say whether the drawing under the certificate of Elisha Foote correctly represents the original drawing?

(Objected to as inadmissible in any way to qualify or affect the certified copy referred to.

The complainants' counsel says that he expects to show by this evidence that the drawing in the certified copy is correctly traced. The master asks counsel for defendants if defendants claim that the drawing is not correctly traced, and counsel for defendants says he knows nothing on the subject at present and makes no claim either

way. The master therefore admits the question *de bene;* rights of defendants reserved to the draft and final reports.)

Ans. I have. It correctly represents the original drawing, with the exception of a cross-line omitted in the certified copy, at the bottom of the lip *c* on the left of Fig. 4, which was probably omitted by the draughtsman.

Int. 9. Have you compared the drawing under the certificate of Elisha Foote with the "Richardson 1866 Drawing, J. G. S., master," under the certificate of M. V. Montgomery, Commissioner, dated Dec. 12, 1885, so as to say whether they are substantially alike or not; and, if so, how do they compare as to the working parts?

(Objected to as inadmissible, as both are certified copies of the Patent Office. Admitted *de bene;* rights reserved as before.)

Ans. I have compared the drawings referred to and find, with reference to the working parts, that they are substantially the same.

Int. 10. Did you compare the valve "Defendants' Exhibit Richardson Valve from Original Drawing, J. G. S., master," with the Patent Office drawing under the certificate of Elisha Foote, so as to be able to say whether or not it correctly represents the same, and, if it does not, in what particulars it varies, and whether those particulars are material?

390 Ans. I have carefully compared said valve with the drawing referred to and find that the valve is not constructed in accordance with said drawing in important particulars. With reference to the lines of the drawing representing the outer edge of the guiding wings B, and the line representing the ground joint F, and the lines representing the interior of the huddling chamber D, I find that the valve is not constructed in accordance therewith. To illustrate this, I caused two templets to be made, one to fit the lines mentioned in the drawing and the other to fit the corresponding parts of the valve. The templet which illustrates the lines of the drawing mentioned and correctly follows the same I now produce.

(Templet produced has stamped upon it "J. W. Gillies, Fig. 4, 1866," and is tagged "Forbes Templet, Richardson 1866 Patent, J. G. S., master.")

The templet illustrating the construction of the corresponding parts of the valve exhibit, I also produce.

(Templet produced has stamped upon it "J. W. Gillies," and is tagged "Forbes Templet of Defendants' Exhibit Richardson Valve from Original Drawing, J. G. S., master.")

It will be seen by comparing this last templet, which represents the valve construction, with the drawing that it does not follow the corresponding lines and shows that the huddling chamber in the valve exhibit is not in the same relative position with the valve seat as indicated in the drawing. It shows that this huddling chamber in the valve exhibit is located near the ground joint of the valve, which materially reduces the size of the stricture, the other parts remaining as shown in the drawing, and this must, with springs

practically employed, greatly affect the operation of the valve, and this I find on trial of this valve to be the case.

On the 15th of March, 1887, I made several trials of this exhibit valve with the same springs and attachments that accompany it, and the results obtained by me were substantially the same as those obtained by Hoadley, as testified to by him on page 430 of the Record, said results showing a reduction at the closing pressure of about thirty-two per cent.

Int. 11. After you had verified Mr. Hoadley's result with this valve (Defendants' Exhibit Richardson Valve from Original
391 Drawing), did you try the exhibit or any portion thereof with different parts in some respect from those in the original exhibit; and, if so, what differences did you make in the parts and what result did you get with the differences you made? And please produce the things which you used for the purpose of getting these different results.

Ans. After I had found that Defendants' Exhibit Valve would operate as testified to by Mr. Hoadley I caused a valve to be made like the certified copy of the patent drawing by Elisha Foote, Commissioner. The changes in construction were the differences I have already pointed out in my comparison with said drawing and Defendants' Exhibit Valve, the other parts of the valve, including the overlap, being made as indicated in the patent drawing. This valve was fitted to connect the same lever and springs used in the Defendants' Exhibit Valve, and also was fitted for trial with springs alone, placed directly on the valve.

My first trials of the valve were made with the lever and spring employed by Mr. Hoadley in his trial with the Defendants' Exhibit Valve. With the No. 6 spring used by Mr. Hoadley, the valve was set to open at a pressure of 100 pounds and closed at the trial at 96½ pounds, showing a reduction of 3½ pounds. I then applied the No. 7 spring used by Mr. Hoadley, and the valve opened at 100 pounds and closed at 94, showing a reduction of 6 pounds. I then removed the lever and spring and substituted a spring directly over the valve. At the first trial I employed an ordinary spring, having a compression of ¼ inch when adjusted to 100 pounds pressure, which is the same strength of spring that has been considered an ordinary spring. The valve opened at 100 pounds and closed at 96¹ pounds, showing a reduction of 3½ pounds.

I then applied a weak spring, having a compression of about ½ inch for 100 pounds pressure. The valve opened at 100 pounds and closed at 95 pounds, showing a reduction of 5 pounds.

I then applied a strong spring, with a compression of a little less than .2 inch for 100 pounds pressure. The valve opened at 100 pounds and closed at 98 pounds, showing a reduction of 2 pounds, or 2 per cent.

The action of this valve was prompt and certain; both the opening and closing action and the overlap of the valve precisely
392 the same as in the valve-head exhibit with overlap in the Defendants' Exhibit Valve.

The valve which I caused to be made and used together with the

direct-acting springs I now produce, the lever and its spring being a part of and attached to the Defendants' Exhibit Valve.

(The valve produced is, by direction of complainants' counsel, marked "Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866, J. G. S., master.")

Int. 12. Did you have occasion, in adjusting this valve to work on a comparatively small margin, to change the stricture in any degree from the size of stricture in the valve produced by the defendants?

Ans. I did. I caused the stricture to be made one sixty-fourth inch wide, in accordance with the directions given in the patent and as substantially indicated in Fig. 1 of the drawing thereof, in which the size of the stricture is distinctly shown.

Int. 13. Taking now Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing and the three springs produced by defendants, marked "Richardson Spring, 100 to 125 Pounds, Ordinary Spring, J. G. S., master;" "Richardson Spring, 80 to 100 Pounds, Weak Spring, J. G. S., master," and "Richardson Spring, 125 to 140 Pounds, Strong Spring, J. G. S., master," and "Defendants' Exhibit Valve Head Like Photo-lithograph Drawing, without Overlap, J. G. S., master," I ask you whether you have examined, tested, and tried said exhibits, and whether you have examined the testimony of Mr. Hoadley and Mr. Harrison about the same, and how your experiments as to the exhibits as produced by the defendants compare as to results with those achieved by Mr. Hoadley and Mr. Harrison.

Ans. I have examined the exhibits referred to, and I have tried the same with the several springs mentioned, and I have also examined the testimony of Mr. Hoadley and Mr. Harrison respecting the same, and I find the results obtained by them as testified to are substantially correct and agree with the results obtained by me.

Int. 14. Have you compared the defendants' exhibit concerning which you have just testified with the photo-lithographic drawing furnished by the Patent Office and in evidence in this case;
393 and, if so, does the exhibit accurately represent said drawing; and, if not, in what particular does it differ as regards working parts?

Ans. I have compared the working parts of the valve with the photo-lithographic copy of the drawing referred to and find that it does not agree with said drawing in important particulars that affect the operation of the valve.

To illustrate the differences between the valve and the drawing, I have caused two templets to be made, one showing the construction of the valve with reference to the outer edge of the guiding wing, the ground joint of the valve, and the huddling chamber. This templet correctly represents the construction of the valve with reference to these parts. With reference to Fig. 3 of the drawing, this templet does not follow the lines corresponding to the similar parts of the valve in these particulars. The lines indicating the ground joint in both Figs. 3 and 4 of the drawings are considerably at variance with the corresponding part of the templet, which will be readily observed by comparing the same. The size of the huddling cham-

ber is also shown to be somewhat contracted in the drawing as compared to the corresponding construction of the valve as shown by this templet. This templet, for the sake of convenience, is made in the same piece with the templet which I have heretofore produced, marked "Forbes Templet of Defendants' Exhibit Richardson Valve from Original Drawing," and is the smaller templet on said piece.

I also produce another templet, constructed to fit the vertical inner wall of the steamway, the ground joint, and the horizontal top of the valve seat outside of the ground joint of this same exhibit, Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing. Upon comparing this templet with the photo lithographic copy of the drawing referred to, I find a great discrepancy, in this: that in the valve the horizontal top of the valve seat is projected upward above the ground joint of the valve head about $\frac{1}{32}$ inch, leaving a circumferential vertical ledge surrounding the ground joint of the valve. This templet has stamped upon one side of it "J. W. Gillies," and upon the opposite side "2" and "L. S. V."

(Templet produced is marked "Forbes Templet, Defendants' Exhibit Photo-lithograph Valve, J. G. S., master.")

394 Int. 15. Did you cause to be made and tried any valve in imitation of this Defendants' Exhibit Richardson Valve from Photo-lithograph Drawing; and, if so, how did you cause it to be tried, and with what results as compared with the Hoadley and Harrison results?

Ans. I did cause to be made a valve precisely like the said defendants' exhibit referred to, and I tried the same March 15, 1887, with the same springs that accompany the exhibit, and I obtained the same results with said valve as testified to by Mr. Hoadley on page 299 of the Record, which established the fact that the valves were alike.

Int. 16. What, if anything, did you do with said new valve to bring it nearer to the shape and arrangement of the photo-lithographic drawing, and with what result?

Ans. In the trials referred to in my last answer a reduction of about 27 per cent. was indicated, the same as in Mr. Hoadley's table. I then removed the circumferential ledge of the valve seat surrounding the ground joint of the valve flush with the top of said joint and in conformity with the photo-lithographic drawing. I then tried this valve with the ordinary spring accompanying the defendants' exhibit and adjusted the same to open at 118½ pounds, which is the point at which Mr. Hoadley tried the defendants' valve in experiment No. 3, on page 299 of the Record, with the same spring. The valve opened at 118½ pounds and closed at 110½ pounds, showing a reduction of 8 pounds instead of a reduction of 30 pounds, the result obtained by Mr. Hoadley, which shows a difference of 22 pounds in the amount of reduction by the change made. I then made the stricture slightly larger by turning out the inside of the downward projecting lip of the valve head an amount within measurements made from the plan views, Figs. 1 and 2, and cross-section, Fig. 4, of the photo-lithographic drawing and made the overlap of

the valve equal to that in defendants' valve. I then applied the weaker spring accompanying the defendants' valve and adjusted the same to open at 100 pounds pressure. The valve opened at 100 pounds and closed at 92 pounds, showing a reduction of 8 pounds. I then substituted the ordinary spring accompanying said defendants' valve, and the valve opened at 100 pounds and closed at
395 94 pounds, showing a reduction of 6 pounds. I then applied the strong spring accompanying said exhibit, when the valve opened at 100 pounds and closed at 96½ pounds, showing a reduction of 3½ pounds.

The operation of this valve was perfect in all its details, opening and closing promptly and with sufficient lift to make an efficent valve.

Int. 17. Did you make any further alterations of the valve which you had corrected from the erroneous dimensions shown in Defendants' Exhibit Richardson Valve from Photo-lithograph Drawing; and, if so, what further alterations did you make and with what result?

Ans. I don't recall any changes at this time other than those I have testified about.

Int. 18. Will you produce, to be marked as an exhibit, the corrected representation of the Richardson valve from photo-lithograph drawing?

Ans. I will and do produce the valve, and will state that it is fitted with another spring, with which I also tried it and which I omitted to mention. This spring I applied as an ordinary Richardson spring, having a compression of ¼ inch for 100 pounds pressure. I made one trial of the valve with the spring, following the trials heretofore mentioned. The valve opened at 100 pounds and closed at 96 pounds, which shows a good operation with said spring.

(Valve produced is marked "Forbes Exhibit Corrected Representation Richardson Valve from Photo-lithograph Drawing, J. G. S., master," and the spring in said valve is marked "Richardson Ordinary Spring, Compress. .25 in. for 100 lbs., J. G. S., master.")

Int. 19. Did you try, upon the corrected exhibit valve produced by you, any other direct-acting spring than the ones already in evidence? If so, please produce it, state what results you obtained, and what the compression of the spring was.

Ans. I did. At the same time I applied a stronger spring, one having a compression of .15 inch for one hundred pounds, for the purpose of ascertaining the action of the valve with such a spring, and also if the amount of reduction could still further be reduced.
With this spring the valve opened at one hundred pounds
396 and closed at ninety-seven pounds, showing a reduction of three pounds, which is less than that obtained with the other springs. I produce this spring.

(Spring produced is marked "Forbes Strong Richardson Spring, Comp. .15 in. for 100 lbs., J. G. S., master."

(Adjourned.)

MAY 6, 1887.

Int. 20. Mr. Hoadley on page 299 asserts that the width of the stricture in the safety-valve represented in the photo-lithographic drawing is .01 of an inch, and that the stricture in the valve produced by defendants as representing this is .01 of an inch. Mr. Harrison concurs as to this. Was this measure verified by you in defendants' exhibit?

Ans. Yes, sir.

Int. 21. Is that the measure given for the width of stricture in the text of the patent?

Ans. It is not In the text of the patent the width of the stricture is stated to be one sixty-fourth-inch for an ordinary spring.

Int. 22. The ordinary spring of the period of the Richardson patent was assumed, without contradiction in the principal case, to have been equivalent to a direct-acting spring compressed .25 inch over the valve for one hundred pounds pressure. If this be correct, which of the three springs mentioned in Mr. Hoadley's table on page 299, and which were submitted to a compression of .31 inch, .40 inch, .27 inch, .35 inch, .29 inch, and .30 inch, was fairly to be considered, in the use to which he put it, an ordinary spring?

(Defendants' counsel calls the master's attention to the fact that the assumption spoken of as in the principal case was an assumption by the complainants.)

Ans. The table referred to as made up by Mr. Hoadley shows that the trials with each of the springs which he calls ordinary, weak and strong, were made under variable opening pressures, apparently for the purpose of obtaining with the different springs a uniform and substantially the same percentage of reduction of pressure. I should consider, from the amount of compression given, the spring which he considers the strong spring, in connection
397 with the pressures at which it was tried, would be the nearest to the ordinary spring defined in the question.

Int. 23. With such a spring, compressed as Mr. Hoadley compressed it, would the stricture, according to the instruction of the Richardson patent of 1866, in order to get a moderate range of reduction, be smaller or larger than one-sixty-fourth inch?

Ans. It would require a stricture of about that size, one-sixty-fourth inch.

Int. 24. When the defendants made the valve, which they have produced as resembling the photo-lithograph drawing, with a stricture of .01 inch, and Mr. Hoadley tested it with the springs and pressures that he has testified to, did he follow the directions of the Richardson patent as to stricture and spring?

Ans. It is evident that he did not. With either of the springs used by him, the stricture was too small to relieve the pressure in the huddling chamber and allow the valve to close at a moderate reduction of pressure. What Mr. Hoadley in his table indicates as a strong spring—that is, having a compression of .30 inch for one hundred and forty-three pounds pressure—can properly be considered a strong spring; but a spring of sufficient strength, with the size of

stricture that he made to lessen the degree of reduction of pressure, would prevent a sufficient lift to the valve for any practical purpose.

Int. 25. What width of stricture did you give to your corrected representation of the photo-lithograph valve?

Ans. It was about one-sixty-fourth inch wide, as indicated in the plan view, Fig. 1, of the photo-lithograph drawing.

Int. 26. Did you make any experiments with either of those valves, the complainants' or defendants', purporting to represent the valve of the photo-lithograph, mounted with extension springs, and the lever appliances shown in Defendants' Exhibit Lever and Attachment (Harrison), Richardson's Photo-lithographic Valve, and Defendants' Exhibit Lever Spring, No. 10 Wire, 100 to 120 Pounds; Richardson Photo-lithograph Valve and Lever Spring, No. 11 Wire, 80 to 100 Pounds; Richardson Photo-lithograph Valve and Lever Spring, No. 9 Wire, 120 to 140 Pounds; Richardson Photo-lithograph Valve?

398 Ans. I did not try these. I made no further experiments than I have indicated with the valve representing the photo-lithograph copy.

Int. 27. There has been produced by defendants a valve marked "Defendants' Exhibit Webster Valve, Fig. 1," a valve marked "Defendants' Exhibit Webster Valve, Fig. 3," and a collection of levers and fittings for use with the levers, which are marked "Lever for Webster, Fig. 1," and "Lever for Webster, Fig. 3." Have you examined these valves and tested them, and do you understand their construction and operation and their relations to the information on the subject of safety-valves given in the Webster patent?

Ans. I have done so and do understand the same.

(Counsel for complainant says that the following examination on the subject is *de bene*, the complainants contending, as before, that the Webster valve has been eliminated from the consideration of the master by the opinion of the Supreme Court, and that its anatomy by the decision of the Supreme Court is the "anatomy of a corpse," and a still-born corpse at that, instead of a living being.)

Int. 28. Mr. Hoadley submitted certain measurements of these valves on page 306, and Mr. Harrison, on page 321, slightly corrects Mr. Hoadley's measurements, and on page 324 gives a series of measurements of the Webster valve with flange resting on top of valve which Mr. Hoadley had not treated of. Will you please to say whether you have any corrections to make in any of these measurements of these exhibits, and whether they correspond to the measurements of the Webster drawings, Fig. 1 and Fig. 3, and to the instructions of the Webster patent with regard to the making of the Webster valve with flange resting on top of the valve?

Ans. With reference to the valves purporting to represent Fig. 1 and Fig. 3 of the Webster patent, my measurements of said valves do not agree with the measurements given by Mr. Hoadley or Mr. Harrison, and said valves are not constructed in accordance with

drawings in the Webster patent in important particulars relating to parts that influence the action of the valve.

I have measured the essential parts of the drawings, Fig. 1 and Fig. 3 of the Webster patent, and find—

(1.) Diameter of steamway, 1.22 inches.

399 (2.) Diameter of lip of flange:

Fig. 1, inside of lip, 2.54 inches.

Fig. 3, outside of lip, 2.36 inches.

(3.) Diameter of wall of chamber:

Fig. 1, outside of wall, 2.47 inches.

Fig. 3, inside of wall, 2.41 inches.

These measurements differ from Mr. Hoadley's with respect to Fig. 1, diameter outside of wall, .02 inch.

The valve introduced by defendants, representing Fig. 1 of the Webster patent, is made in accordance with Mr. Hoadley's measurements, and by increasing the diameter of the outside wall of the chamber .02 inch the width of the stricture has been accordingly made .01 inch in the valve smaller in width than the stricture indicated in the drawing.

With reference to Fig. 3 of the drawing of the patent, I find the diameter outside of lip of flange to be 2.37 inches instead of 2 36 inches, as indicated by both Mr. Hoadley and Mr. Harrison. The valve introduced by the defendants is made in accordance with Mr. Hoadley's measurements, and the difference which I have pointed out in the diameter of the outside of lip of flange has correspondingly reduced the width of stricture in the valve.

The valve referred to in the question, made and tested by Mr. Harrison, with the flange resting on the top of the valve, I find to be constructed substantially as indicated in the patent.

In connection with the reduced width of stricture in the valves purporting to represent Figs. 1 and 3 of the patent, I find Mr. Hoadley, in his trials of such valves, has employed a very strong spring, having a compression of .18 inch per one hundred pounds.

Int. 29. Mr. Hoadley's experiments with these valves, in which he got moderate reductions of pressure of about two per cent. and from two to seven per cent., characterize the action of the valves as follows:

"The pop was clear, full, and distinct, generally without distinguishable warning; the closure prompt, full, and tight; the reduction, two pounds, = two per cent., and the pressure was kept uniformly between the limits of one hundred pounds popping pressure and ninety-eight pounds closing pressure. The action was in all respects admirable."

400 Mr. Harrison says:

"The action was good; the valves opened well; good lift; relieved the boiler according to the amount of the overlap, and closed of their own accord."

Were you able, in the experiments that you made with those valves, to get any result that could properly be characterized according to the quoted language of Mr. Hoadley or Mr. Harrison?

Ans. In my experiments with these valves I was not able to ob-

tain such results stated to have been obtained by Mr. Hoadley and Mr. Harrison. I found great difficulty in adjusting the flange of the valve up and down with the means contained in the valve, consisting of a set-screw passing through the top of the flange and bearing upon the smooth spindle of the valve.

Mr. Hoadley indicates in his table of results of his experiments with these valves (pages 306 and 307) a uniform and definite adjustment of the flange of .005 inch in a range in one direction between .005 inch and .025 inch, and in the opposite direction in a range between .01 inch and .015 inch. Such a micrometer adjustment as this, with the means employed, I found it impossible to practise. Even the turning of the screw upon the smooth surface of the spindle almost invariably varied the adjustment.

I conducted my experiments with these valves with great care to adjust the valve as near as possible in accordance with the positions of the flange stated by Mr. Hoadley in the tables referred to.

With reference to the position of the flange above the top of the surrounding wall of the supplemental chamber, which Mr. Hoadley has called clearance, these valves failed to operate as pop valves and with very inferior action compared with the ordinary safety-valve. The valves were set to open at the same pressure at which Mr. Hoadley tried them, and failed in this position of the flange to pop open and close suddenly like a pop valve.

I also made a great many experiments with these valves with the flange adjusted below the top of the surrounding wall of the supplemental chamber, which Mr. Hoadley designates as overlap and Mr. Harrison as immersion, with reference to the valve represented — Fig. 3.

401 At an occasional point of adjustment the valve operated somewhat better than at intermediate points of adjustment of the flange, but in nearly every instance the opening action of the valve was anticipated by a leaking of the steam, called warning, several pounds below the pressure at which the valve was adjusted to open.

In the closing action of these valves, which were substantially alike in respect to operation, in most instances the valve would partially close at a moderate reduction of pressure, but did not completely close until the pressure had fallen in the boiler at least twelve per cent., and in many instances more than twenty per cent.

These valves I consider an impractical, inefficient valve.

The time of the closing action of the valve from the point at which it opened is nearly twice as long as in the Richardson valves. The valves cannot be adjusted to close within a practical amount of reduction of pressure, and are inferior in their operation to the ordinary safety-valve.

The valve made by Mr. Harrison I also tried at the points of adjustment indicated by him on page 324 of the Record.

With the flange resting on top of the valve and set to open at 100 pounds pressure, it began to warn at 90 pounds, opened at 100 pounds, partially closed when the pressure had reduced to 87 pounds, and did not completely close until the pressure was reduced to 96 pounds.

With the flange adjusted to .005 inch, the amount of overlap, the valve warned or partially opened at 90 pounds, completely opened at 100 pounds, partially closed at 96 pounds, and fully closed at 84 pounds.

The action of this valve was very poor. The pop action at the opening was slight and barely distinguishable, and the valve had no practical lift that would insure a proper discharge of steam in accordance with its size.

These experiments confirm my former experience with this Webster valve.

Counsel for complainants says that, in view of the discrepancy of characterization of the work of these Webster valves by the witnesses Hoadley and Harrison for the defendants and Forbes for the complainants, and in view of the fact that in reality the valve itself is the witness and the oral testimony of the experts is simply a
402 translation of the dialect of steam into the dialect of Englishmen, the master is desired to attend, at some convenient time to himself, an examination of said Webster valves by the testing apparatus under control of the complainants, at Bridgeport, Conn.; to which examination defendants' counsel and expert may be invited by the master, with permission to suggest and, in a reasonable way, operate the valves, and at which examination complainants will have Mr. Forbes present, on their part, to operate the valves, and where reasonable facilities in the shape of steam-gauges and operatives will be afforded for any demonstration, desired by the master or approved by him at the suggestion of either party, to ascertain whether the testimony given by the valves themselves has been properly interpreted in English, with regard to the practical demands of business for pop safety-valves, by the gentlemen who have undertaken to interpret.

Counsel for defendants says that, if the master esteems it desirable, beyond the testimony in this accounting proceeding, to see the practical operation of the exhibits introduced into this proceeding by the parties, they, defendants, — ready to join complainants in providing an opportunity for him to see these practical operations, which shall be outside of either party to this case and conducted as fairly and equitably as they can be, and to this end they are willing to share equally the expense with the complainants, and the same shall be wholly under the direction of the master.

Complainants' counsel replies that there are in this country three suitable gangs and apparatuses for making these tests, and, so far as he knows, only three. Two of them belong to defendants in suits brought by the complainants. Complainants are ready to accede to two sets of experiments before the master, under the conditions hereinbefore stated, as to the right of either party at either set of experiments to suggest to the master and of the master to order work to be done which may be suggested, one set of experiments to be make at the plaintiffs' works and one set at the defendants' works, but he does not see the necessity of bearing half the expense of fitting up an apparatus for making experiments when the two appa-

ratuses which have been used to extort the testimony of the valves from them are still in existence and in working order. The
403 thing which is to be determined is what the experiments that have been talked about showed in the same English language that has been used in describing the action of other valves. This can best be determined by the things that were used before. After they have disagreed, it will be time enough to appoint another boiler umpire.

MASTER: I have considered the above formal statements and the arguments of counsel for both parties thereon. It is my duty to "regulate all the proceedings" upon this hearing according to my best judgment, so as to accomplish the object of the reference in as convenient and expeditious a manner as possible. In doing this I must take into consideration the fact that my findings are subject to review by the court. The proceedings before me thus far have been so conducted that all the evidence before me has been preserved and can be reported to the court if I shall hereafter determine that it is proper that I should report it. If the action under steam pressure of these Webster valves, or of any of the exhibit valves in this case, is witnessed by experts, and these experts testify with relation thereto before me, they are subject to cross-examination, and counsel as skilled as the counsel in this case will doubtless elicit the facts with relation to the behavior of these valves in such form that I can make satisfactory findings as to that behavior, and the evidence upon which such findings are based can be reviewed by the court if necessary. If, however, I witness the action of these valves under steam pressure, and base my findings upon what I have seen, I become, in a certain sense, a witness in the case who cannot be cross-examined and whose testimony is practically conclusive and final. In the present condition of this case I do not think it advisable for me to put myself in this position.

I think it proper, however, to say that, if the counsel for both parties in this case should agree upon any experiments which I should witness, I would gladly avail myself of the opportunity of obtaining knowledge which such experiments would afford and which might aid me very much in deciding the issues before me.

Int. 30. Did you examine and measure the Defendants' Exhibit Waterman 1853 Patent, and, if so, did you find it to be made
404 conformably to the instructions of the Waterman patent of 1853, contained in the record in this court at page 423?

Ans. I have not compared this exhibit with any measurements whatever with reference to the Waterman patent.

Cross-examination by J. H. MILLETT, Esq., of counsel for defendants:

Cross-int. 31. Is the only difference between Defendants' Exhibit Richardson Valve from Original Drawings and the valve shown in Foote's certified copy to be found in the difference which you say exists between two templets, one said to be a templet of certain lines of the valve and the other of corresponding lines of the valve shown in the drawing?

Ans. It is the only difference that I am able to testify about at this time. I think, however, that the valve head is of smaller diameter than that shown in three of the figures of the drawing, but this I could not testify about definitely without measuring the same.

Cross-int. 32. This statement, then, is the result of inspection only, and not measurement, is it not?

Ans. Yes, sir.

Cross-int. 33. You have said that Defendants' Exhibit Richardson 1866 Drawing was the same as the Foote certified copy testified of by you, have you not?

Ans. Yes, sir.

Cross-int. 34. Then any difference between the defendants' valve exhibit and the valve shown in the Foote drawing would be also seen in Defendants' Exhibit Richardson 1866 Drawing, would it not?

Ans. Naturally it would.

Cross-int. 35. Did you make any measurements of said defendants' exhibit valve?

Ans. I did.

Cross-int. 36. What parts did you measure?

Ans. The external diameter of the valve-seat and casing E, the diameter of the steamway, and the diameter of the valve and extended flange inside the downward projecting lip.

405 Cross-int. 37. Please give them.

Ans. The measurements were made with inside and outside calipers applied to the parts of the valve mentioned and then applied to the figures of the drawing for comparison. I cannot state what the measurements are in figures.

Cross-int. 38. To what figures of the drawing were these measurements applied?

Ans. I compared them with all of the figures.

Cross-int. 39. What does Fig. 1 show in Defendants' Exhibit Richardson 1866 Drawing?

Ans. It is a bottom plan view of a valve and its seat, taken, I should judge, on a horizontal line passing through the top of the valve-seat casing.

Cross-int. 40. What does Fig. 2 show?

Ans. It shows a bottom plan view of the valve taken separately.

Cross-int. 41. What does Fig. 3 show?

Ans. It shows a central vertical section of the valve and the seat taken together.

Cross-int. 42. Is it not a cross-section of the valve and the valve body through the lines *x x*, Fig. 1?

Ans. It is so stated to be that in the patent.

Cross-int. 43. And it shows, does it not, the relation of the parts seen in Fig. 1?

Ans. I think not. If I remember, according to my measurements the valve shown in Fig. 3 is of less diameter than as shown in Fig. 1, or the valve casing is of greater diameter. I can ascertain these facts by measurements, but, as near as I can now remember, the size of the parts referred to in the respective figures do- not correspond either in one or the other distinctions which I have made.

Cross-int. 44. Which of the two figures, 1 or 3, then, shows the true relation of the parts of the Richardson safety-valve complete, described in the specification of which these figures are drawings?

Ans. The plan view, Fig. 1, as I remember it.

Cross-int. 45. If, then, you should strike from the specification all the description of Fig. 3 as well as Fig. 3, would you be enabled, without more knowledge than conveyed to you by what remained, to construct a Richardson valve as claimed?

406 Ans. I would.

Cross-int. 46. And you think also, do you not, that any one skilled in the art of making safety-valves at the time of the date of the patent could also make such safety-valve?

Ans. I do.

Cross-int. 47. Will you please indicate from the specification all those portions which you think could be removed as referring to Fig. 3?

Ans. In the second paragraph of the printed copy of the specification the words "Fig. 3 is a vertical section at *x x*, Fig. 1, of valve and seat."

In the fourth paragraph the letters "E E" and the letters and words "E E is the valve seat."

In the seventh paragraph, line 18, "E E, Fig. 3;" the letters "E E," line 24.

The whole of the eighth paragraph.

In the ninth paragraph the words "escaping in the direction indicated by the arrows in Fig. 3," and the letters "E E" in the eleventh line.

Cross-int. 48. Then a valve made like Fig. 3 would, or would it not, have its parts properly related and as required by the specification and claims of the Richardson patent?

Ans. A valve made in accordance with Fig. 3, having its parts related to each other as described (and pointed out by the drawings given) in the text of the patent, would be in accordance with said patent.

Cross-int. 49. Then I am to understand that if I make a valve according to the directions in the specification and as illustrated by Fig. 3 the parts of such valve complete would be in proper relation to each other?

Ans. They would.

Cross-int. 50. Then, when the patent says that "Fig. 3 is a vertical section at *x x*, Fig. 1, of the valve and seat in position" the reader is to understand, upon inspection of Fig. 3, that it truly represents Fig. 1, as declared?

Ans. Not necessarily.

Cross-int. 51. Why not?

407 Ans. Because I should consider, in view of the directions given in the patent with reference to the important parts of the construction, that Fig. 3 was merely a side picture showing an assembled valve capable of alteration to conform to the directions given in the patent with reference to the width of the stricture, amount of overlap, etc.

Cross-int. 52. And that was the reason which governed you in your alterations of Complainants' Exhibit Forbes Exhibit Corrected Representation Richardson Valve from Photo-lithograph Drawing, testified of by you in answer to Int. 16?

Ans. The valve referred to in the question was first constructed like a valve introduced by the defendants, purporting to represent the photo-lithographic drawing. The alterations which I made in the valve were made in conformity with the Richardson patent.

Cross-int. 53. Of which patent you did not consider Fig. 3 a part, did you, in making those changes?

Ans. I did; I considered the whole patent.

Cross-int. 54. Why, then, were you so careful in your answer to say that these alterations were made in accordance with Figs. 1, 2, and 4?

Ans. Because in such figures the relation of the working parts of the valve more nearly conformed to the sizes definitely stated in the patent.

Cross-int. 55. What does Fig. 4 show?

Ans. A vertical section of the valve taken separately.

Cross-int. 56. Is it not a cross-section of Fig. 2?

Ans. It is so stated to be in the patent.

Cross-int. 57. When parts are seen separately in the drawings, and then in other drawings are brought together—as is said here that Fig. 3 represents the valve and seat in position—does not the drawing, showing the assembling of these separate parts, disclose the understanding of the patentee or inventor of the proper relation of these parts?

Ans. It does not; particularly when definite directions are given in respect to the relation of such separated parts when they are to be assembled.

Cross-int. 58. So that I am now to understand that if De-
408 fendants' Exhibit Richardson Valve like Original Drawing should appear to be like Fig. 3 in cross-section in all its material parts it would not be like the valve described in the Richardson patent?

Ans. If the valve was constructed strictly according to the lines of Fig. 3 of the drawing, without reference to the directions given in the text of the patent, it could not be said to be made in accordance with said patent.

Cross-int. 59. But if such valve was made strictly in accordance with the drawings, Figs. 1, 2, and 4, then such safety-valve would be within the patent, would it not?

Ans. It would if it operated as described in the patent, regardless of the directions given in the patent. I have never made a valve made from such drawings alone and without reference to the directions given in the text of the patent.

Cross-int. 60. The reason, then, that Fig. 3 is condemned by you is that, if followed, the valve won't work well?

Ans. I have not condemned Fig. 3. A valve constructed like Fig. 3, its parts fitted and assembled together as described in the

text of the patent, I have no doubt will operate as described in the patent.

Cross-int. 61. So you wish to withdraw the characterization of Fig. 3 as a mere side illustration, and also your understanding of it that the parts are not properly related to each other?

Ans. I withdraw nothing that I have said with regard to it.

(Adjourned.)

MAY 9, 1887.

Cross-int. 62. What is the size of Complainants' Exhibit True Representation of Richardson Valve from Original Drawing of 1866, taken in the steamway?

Ans. I think about two and one-fourth inches. The valve is constructed from the drawing, I think, a two and one-fourth inch valve.

Cross-int. 63. Complainants' Exhibit Forbes Templet, Richardson 1866 Patent, I understand, represents the line of the guide wings, ground joint, and upper part of chamber D, in Fig. 4. Is that correct?

Ans. Yes.

Cross-int. 64. What is the object of the guide wings of a valve?

409 Ans. To keep the valve in a vertical position.

Cross-int. 65. They perform the same office in the Richardson valve of the patent that they do in the common valve, do they not?

Ans. They fill the same office.

Cross-int. 66. In size they are just enough smaller than the steamway, where they are located, as to permit the valve to operate freely. Is not that so?

Ans. Yes, sir.

Cross-int. 67. The relation, then, of the added part *c* outside the lines *p p* and the ground joint is only of importance in construing Fig. 4. Is not that so?

Ans. No; I think the vertical line representing the edge of the guide wing is also of importance.

Cross-int. 68. Why?

Ans. To prevent a cocking of the templet, by which the position of the chamber D could be varied.

Cross-int. 69. Am I to understand, then, that it is necessary to have the guide wing shown in order to know what is the true relation and location of the ground joint and chamber D?

Ans. In my opinion, that is the proper way to measure it.

Cross-int. 70. If the guide wings shown in Fig. 4, which Richardson says in his patent are the guide wings of a common safety-valve, to which is added his improvement, shown outside the dotted line *p p*, were complely cut away and in their place there was fixed a guiding stem passing through a bar connecting the walls of the steam space, so that it could move freely, would a valve so constructed, in your opinion, be any less a valve of the patent?

Ans. I should think not, as I understand the question.

Cross-int. 71. Then the guide wings, as shown in Fig. 4, are not an essential element in the Richardson combination, are they?

Ans. No, sir; they are not an essential element.

Cross-int. 72. If a templet was made to conform exactly to the line of the ground joint and the upper part of chamber D, as seen in Fig. 4, excluding the guide wing shown, would not such templet show the exact relation and location of the ground joint and the upper part of the chamber?

410 Ans. Of course it would.

Cross-int. 73. Will you please lay upon Fig. 3 the templet, Forbes Templet of Defendants' Richardson Valve from Original Drawing, so that the line showing the ground joint and the upper part of the chamber shall correspond with the line of the drawing, and tell me whether or not the line of one is substantially the line of the other?

Ans. It is not the same.

Cross-int. 74. Please give the variance.

Ans. The lines referred to in the question, on the right-hand side of the figure of the drawing, correspond to the templet, except at the outer side of the chamber. At the left-hand side of the figure of the drawing the templet corresponds with the ground joint and top of the chamber and does not correspond with either side of the chamber.

Cross-int. 75. Do you know how that templet was made?

Ans. Yes, sir.

Cross-int. 76. Please tell us.

Ans. A piece of sheet metal was cut and filed up on its edges to correspond to the lines of the valve.

Cross-int. 77. That is, the workman with his file and other tools endeavored to fit the templet to the interior part or recessed part of the interior of the valve?

Ans. Yes, sir; the templet was fitted to bear upon the edge of the guide wing of the valve, a part of the ground joint, and within the recessed part.

Cross-int. 78. Please to lay the templet, Forbes templet, Richardson 1866 patent, upon Fig. 3, so that the ground joint and chamber line shall correspond, and state what difference there is.

Ans. I have done so. On both sides of the figure that part of the templet representing the chamber is smaller than the corresponding lines of the drawing; and, on both sides of the figure, the lines of the templet representing the ground-joint lines of the drawing have a parallel variation of about one-sixty-fourth of an inch, I should judge.

Cross-int. 79. Please let the ground-joint lines coincide and tell me the variation of the chamber lines.

411 Ans. On the right-hand side of the figure the top of the chamber line is within the corresponding part of the templet, and the outside chamber line is outside the corresponding part of the templet. The same is true of the left-hand side of the figure.

Cross-int. 80. Does not the templet showing lines in defendants'

valve more correctly represent the corresponding lines in Fig. 3 than the other templet?

Ans. Neither of those templets correctly represent the lines of Fig. 3 of the drawing. The templet, Forbes templet, Richardson 1886 patent, was not made in accordance with Fig. 3 of this drawing, but was made in accordance with Fig. 4, which it correctly represents.

With reference to Fig. 3, the principal variation with this templet lies in the depth of the chamber D, which is of very little consequence, and also in the width of said chamber, the chamber being slightly wider than the templet. The variation of the lines of the drawing in Forbes templet of Defendants' Exhibit Richardson Valve from Original Drawing is in the position of the chamber with respect to the ground joint of the valve, the templet indicating the location of the chamber much nearer the ground joint than the lines of the drawing show. Both these templets, in making the respective comparisons, I have placed upon the drawing in the same position and exactly in line with the ground joint and the edge of the wing of the valve.

To more directly answer the question, this Forbes templet, of Defendants' Exhibit Richardson Valve from Original Drawing does not so nearly correspond to Fig. 3 as the templet Forbes templet, Richardson 1866 patent.

(Adjourned.)

MAY 10, 1887.

Cross-int. 81. In answer to cross-int. 74 you say that the lines on the right-hand side of the figure of the drawing (Fig. 3) correspond to the templet, except at the outer side of the chamber. Please state how they do not correspond there.

Ans. The answer to cross-int. 74 refers to a comparison of the templet with the drawing with reference to the ground joint and the chamber and without reference to the vertical lines of the drawing representing the guide wings of the valve and the outer edge of the valve-seat casing. With the templet applied with reference to the ground joint and the chamber, it covers or laps over the line representing the outside of the chamber.

412

Cross-int. 82. In the answer to same cross-interrogatory you say the templet corresponds with the ground joint and top of the chamber and does not correspond with either side of the chamber on the left-hand side of Fig. 3. Please describe this want of correspondence.

Ans. The templet covers or laps over the lines on both sides of the chamber.

Cross-int. 83. Did you make any measurements of the parts of the Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866 so as to give the dimensions of these parts in figures?

Ans. Only with reference to the width of the stricture. The parts of the valve are constructed in accordance with the drawings

of the patent and the sizes of the parts are determined by the use of caliper tools.

Cross-int. 84. Please give the lifts of the valve at the several trials which you made, stating the kind of spring that you used.

Ans. I did not measure the lift of the valve. The valve opened wide in all instances, which could be readily observed by its free delivery. The springs employed were an ordinary spring having a compression of .25 in. for 100 lbs. pressure, a weak spring having a compression of .50 in. for 100 lbs. pressure, and a strong spring having a compression of, I think, about .20 in. for the same pressure.

Cross-int. 85. What was the width of the stricture of this exhibit?

Ans. One-sixty-fourth inch.

Cross-int. 86. Do you consider that width of stricture the proper width for a two and one-fourth inch valve?

Ans. It is for a certain strength of spring operating under a given pressure. A reasonable reduction of pressure is obtained with this size of stricture when an ordinary spring is employed at one hundred pounds opening pressure. If a stronger spring is used the size of the stricture must be diminished, and if a weaker spring is
413 used the size of the stricture must be enlarged in maintaining the same reduction.

Cross-int. 87. What is the amount of the overlap of the lip in this exhibit?

Ans. It is the same as in the corresponding defendants' valve with overlap.

Cross-int. 88. Did you measure the parts of Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing so as to give the dimensions in figures?

Ans. No, sir; I compared the same with the drawing by caliper and templet measurements.

Cross-int. 89. You have said that you found what you call "a circumferential vertical ledge" surrounding the ground joint, which was about one thirty-second of an inch high, and that you caused that ledge to be removed, and that the valve afterwards worked better. Please describe how you did that.

Ans. I first made a valve precisely like the defendants' valve, which included the vertical ledge. After I had removed the vertical ledge I fitted another valve head in order to preserve the same overlap as in the first instance and as in defendants' valve.

Cross-int. 90. Is that valve an exhibit in this case? If so, please point it out.

Ans. Yes; it is Forbes Exhibit Corrected Representation Richardson Valve from Photo-lithograph Drawing.

Cross-int. 91. What is the width of the stricture in this exhibit, and at the time you made the trial?

Ans. At the first trial it was the same as in the corresponding defendants' valve, and at the later trial the stricture was corrected and made wider in accordance with the photo-lithograph drawing, as indicated in Fig. 1, plan view—that is, after the ledge was removed.

Cross-int. 92. That is, at the first trial the stricture was .01 inch and the overlap .025 inch?

Ans. I don't know; it was the same as in the defendants' valve.

Cross-int. 93. At the first trial you employed, as you say, the "ordinary spring" of the defendants' valve, the valve opening at one hundred and eighteen and one-half and closing at one
414 hundred and ten and one-half pounds steam pressure. Do you know what the compression of that opening was at one hundred and eighteen and one-half and also at one hundred pounds pressure?

Ans. The trial referred to in the question, I understand, refers to the first trial with the corrected valve. I simply employed the ordinary spring referred to, and compressed it the same as Mr. Hoadley compressed it in his trial to resist the same pressure—one hundred and eighteen and one-half pounds. I do not think I otherwise measured the compression.

Cross-int. 94. What was the width of the stricture at the time of the second and subsequent trials of said exhibits?

Ans. It was the same as it is at present. I do not think the stricture was changed after correction in conforming it to the photo-lithographic drawing.

Cross-int. 95. What was that?

Ans. I could not give it to you in figures; it was the same as now, and as in the drawing which it represents.

Cross-int. 96. Is it more or less in width than .01 inch?

Ans. It is more.

Cross-int. 97. Is it one-sixty-fourth inch?

Ans. I could not say; I haven't measured it.

Cross-int. 98. Is it more or less than one-sixty-fourth inch?

Ans. I could not say without careful measurement of it.

Cross-int. 99. Do you consider that one-sixty-fourth inch is the proper width of a stricture for the valve described in the Richardson patent of any size of steamway?

Ans. That depends entirely upon the strength of spring employed.

Cross-int. 100. Please answer the question with reference to a spring having a compression of .25 inch for one hundred pounds pressure, which you have styled "ordinary."

Ans. I have never had occasion to test a Richardson valve other than those constructed in accordance with the original and photo-lithographic copies of the drawings of his patents. With a compression of spring of .25 inch for one hundred pounds opening pressure, with the smaller sizes of valve—that is, from two inch
415 in diameter down—the stricture would naturally be increased in width, I should judge, in obtaining a moderate reduction of pressure.

Cross-int. 101. Why did you cause the stricture in Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866 to be made one-sixty-fourth inch in width?

Ans. Because the patent so directs.

Cross-int. 102. In what way?

Ans. The valve referred to is made in accordance with the drawings attached to the patent, and the text of the patent with reference to the drawings states: "This flange or lip *c c*, fitting loosely around the valve seat E E, is separated from it by about one-sixty-fourth of an inch for an ordinary spring or balance." This refers to the width of the stricture.

Cross-int. 103. To what size of valve, if any, does it refer?

Ans. About two and one-fourth inches in diameter.

Cross-int. 104. A valve having its parts of about the size, proportion, and form shown in the drawing?

Ans. Yes, sir.

Cross-int. 105. Then a valve having a 2¼ steamway, with an annular chamber, D, as described in the patent and shown in the drawings, surrounding the ground joint, would require a stricture of $\frac{1}{64}$ inch in width, and the maker of such a valve, following the description and the drawings, would be instructed so to make it, would he not? In speaking of the drawings I refer to the original drawings.

(Objected to because the question omits an essential feature of the Richardson patented valve, namely, the additional area over the huddling chamber and its relation of size to the initial area or area of the steamway, which relation in the principal case was insisted upon on all sides as a matter of essential consideration.

Counsel for defendants says that he supposed, in referring in the question to the annular chamber D, he embraced the parts referred to in the objection of complainants' counsel, and would like to have the question answered as though those parts were in the question.)

Ans. The purchaser or user of the valve would probably state his purpose or use of the valve, which might demand more or
416 less amount of reduction of pressure or more or less amount of delivery. A valve made as suggested in the question would, with an ordinary spring, give a free delivery of steam, and indicate a reduction of pressure of about four pounds when set to open at one hundred pounds. If a greater or less reduction of pressure was demanded by the purchaser, the maker would, in accordance with the directions of the patent, alter the size of the stricture to conform to the requirements of the purchaser.

Cross-int. 106. Is that the best way, the most intelligent way, you can answer the question?

Ans. It is; and I think the answer is as clearly stated as the question.

Cross-int. 107. Let us be plainer. Are there any instructions in the patent for making the width of the stricture of the valve there described?

Ans. Yes, sir; very full instructions.

Cross-int. 108. Are there also instructions in that patent for making the stricture of a valve which has a steamway of any other size than that shown in the original drawing?

Ans. The patent, I believe, contains no specific instructions relating to valves varying in sizes. It is clear, however, from the directions given in the patent, that with any size valve the width of the

stricture would be conformed to the spring employed by making it of greater or less width to obtain the amount of reduction of pressure desired.

Cross-int. 109. Of width greater or less than what?

Ans. That indicated in the patent.

Cross-int. 110. How long have you been of this opinion, as to the patent giving full instructions as to the making of a stricture in a valve which conforms to the other parts shown in the drawing?

Ans. Ever since I fully understood the patent; I presume six or seven years.

Cross-int. 111. You were a witness, were you not, in the case of these complainants against Erastus B. Kunkle, and gave testimony therein?

Ans. Yes, sir.

417 Cross-int. 112. In a transcript of record in that case, which is an exhibit in this case, on page 98, I find as follows:

"Cross-int. 81. What instructions does this patent give to the manufacturer as to the size of the escape opening to be added in a valve of the size, proportion, and shape shown in this drawing, if any?

Ans. There is no allusion to any particular sized valve in the patent that I observe, except the size indicated by the illustration.

Cross-int. 82. Mr. Reporter, will you please repeat to the witness cross-question No. 77; and, Mr. Forbes, will you please give me a definite answer thereto?

(Cross-question 77 repeated to witness.)

Cross-int. 77. I understand you to have frequently testified, both in this and in the Crosby case, that the object of the Richardson invention was to construct a valve so that, in operation with a hundred pounds pressure to the square inch, it would close with a reduction of five pounds or less in boiler pressure, and that the essence of Richardson's invention of 1866 was in so proportioning four parts to each other as that they would accomplish this result; and you have just stated that the three parts named, to wit, first, an ordinary spring of a quarter of an inch in compression under one hundred pounds of steam pressure; second, a supplemental chamber of the capacity shown in this drawing; and, third, its horizontal area in the proportion shown in this drawing being given, the Richardson patent instructs you as to what size and proportion of escape opening to add to complete a valve so as to attain the object of the Richardson invention. Now, I want to know, for such a valve as shown in this drawing, as to these three parts, what the size and proportion of the fourth part should be; or, in other words, what the Richardson patent instructs you to add for the escape opening to complete a valve which would so operate.

Ans. I do not wish to be understood as stating that the Richardson patent of 1866 lays down definite data from which any given sized valve may be constructed to operate with a definite degree of reduction of pressure. Such a result cannot be determined from the Richardson patent.

Cross-int. 83. Then I understand you that the Richardson patent does not sufficiently instruct the manufacturer in advance as to the exact proportion or size of the escape opening to add to the other three parts of this drawing in order to construct a valve which, when completed, will operate with a reduction of boiler pressure which he may desire?

Ans. No, sir."

Have you changed your views in relation to the data of the Richardson patent from those which are expressed in what has been read to you?

418 Ans. No, sir. It is to be understood that the instructions referred to in the Richardson patent are not specific in figures, for instance, as applied to valves of different sizes, but with the instructions therein given in relation to the valve illustrated, showing that the size of the stricture is governed entirely by the strength of spring employed, I should consider a person very stupid who could not understand from that, with reference to any size of valve, that the size of the stricture was the controlling element.

Cross-int. 113. Did you make any measurements of Complainants' Exhibit Forbes Exhibit Corrected Representation Richardson Valve from Photo-lithograph Drawing, so as to give the dimensions of its parts in figures?

Ans. I only measured this valve and compared it with the photo-lithographic drawing with templets and caliper tools.

Cross-int. 114. Will you please give the compression of the springs mentioned in Int. 22 at one hundred pounds?

Ans. I don't think I measured the compressions.

Cross-int. 115. Please give the lifts of the valve mentioned in cross-int. 113 at the several trials you made with it.

Ans. I did not measure the lift of the valve. I observed from the action of the valve that the lift was good and sufficient. This can readily be observed by the free discharge of steam.

Cross-int. 116. Did you measure the Webster valve with flange resting on top of the valve? If so, can you give your measurements in figures?

Ans. I measured it with caliper tools only.

Cross-int. 117. You say that you find it "to be constructed as indicated in the patent." Is not this valve formed by cutting down or dispensing with the hollow cylinder which surrounds the valve proper in Fig. 1 of the drawings?

Ans. That is as I understand it.

Cross-int. 118. On page 324 of these accounting proceedings Mr. Harrison makes the diameter of the valve-seat 2.49 inches. Did you so find it?

Ans. I don't think I measured it in inches with reference to that valve.

419 Cross-int. 119. In answer to Int. 28 you give a table of dimensions of parts of the Webster valve, as shown in Figs. 1 and 3, and you say that "these measurements differ from Mr. Hoadley's with respect to Fig. 1, diameter outside of wall, .02 inch,"

and that the valve exhibit introduced by defendants was made in accordance with Mr. Hoadley's dimensions. When were these measurements of yours made?

Ans. At the time of the trials of the valves.

Cross-int. 120. In the principal case, in you deposition there given, on page 339, in answer to Int. 23, I notice the following:

"13. Average circumference of space between edge of flange and wall of chamber, 7.9 inch."

These figures are under a column headed "Webster patent, Fig. 1." Please give me the diameter of a circle having that circumference.

Ans. The diameter called for appears to be 2.5146 inches.

Cross-int. 121. In the same answer I find as follows:

"12. Distance between lower edge of flange and wall of chamber, .025 inch."

These figures are in a column headed "Webster patent, Fig. 1." Please subtract these figures from those given in your last answer and state the result.

Ans. 2.4896 inches.

Cross-int. 122. Those figures will represent the diameter of Fig. 1 outside of wall, will they not?

Ans. Yes.

Cross-int. 123. Please give the lifts of the valves of the Webster exhibits at the trials which you made of them.

Ans. I did not measure the lifts. I observed the operation of the valves at the trials.

Direct examination resumed:

Int. 124. On page 338 of the evidence in the principal case, No. 2 gives for a valve called Webster No. 3, Defendants' Exhibit 11, a measurement across the compensation flange under the lip,
420 and on page 339, in answer to Int. 23, you give the diameter of compensation flange for Webster patent, Fig. 1, at 2.65 inches. Do you know whether that measurement was taken inside or outside of the lip?

Ans. I do not; I presume it was taken outside.

(Complainants' counsel calls attention to the fact that in the principal case Mr. John C. Hoadley, on page 161, gave the following dimensions of the parts, of which he gives dimensions on page 306 of these proceedings:

Diameter of steamway, Fig. 1	1.24	inches.
" " " " 3	1.21	"
" " lip of flange, Fig. 1, inside the lip	2.54	"
" " lip of flange, Fig. 3, outside the lip	2.37	"
" " wall of chamber, Fig. 1, outside the wall	2.46	"
" " wall of chamber, Fig. 3, inside the wall	2.43	"
Horizontal width of stricture, Fig. 1	.04	"
" " " " Fig. 3	.03	")

Int. 125. In stating the discrepancy between the valve produced by the defendants and the valve shown in the drawing did you

measure on a scale the whole diameter of each, the drawing and the valve, or did you caliper the valve and then measure the difference between the calipered diameter and the drawing?

Ans. This discrepancy between my measurements and those given by Mr. Hoadley in reference to the outside diameter of wall of chamber is .02 inch. I measured Fig. 1 of the drawing of the Webster patent and the defendants' valve, stated to represent the same, at the same time. I applied a pair of outside calipers to the outside of the wall of the chamber, and then applied the calipers to the corresponding part of Fig. 1 of the drawing. I found a discrepancy here in a difference of .02 inch between the valve and the drawing. I think I measured the calipers adjusted to the valve and deducted the .02 inch, which would make the corresponding
421 part of the drawing smaller in diameter to that amount. I can only state my method of measurement from recollection, but I can positively state that the variation mentioned actually exists.

Complainants' counsel says there are a number of witnesses which have been produced before the master, and marked as exhibits in this cause, whose testimony has not been given in the presence of the master; and the master is requested to adjourn this hearing, to some time convenient to himself, to the testing-room of the Consolidated Safety Valve Company, at Bridgeport, Conn., where these witnesses can be examined and give their own testimony to the master, the witnesses referred to being the various valves introduced in evidence by the plaintiffs and defendants before the master. The evidence offered is primary evidence as to the behavior and conduct of the valves under steam. The evidence about them hitherto is secondary evidence, and the complainants claim as a right to introduce primary evidence in this behalf.

Defendants' counsel says that he desires to take from the files the exhibits introduced by the complainants in the examination of Mr. Forbes, the last witness, for the purpose of examination and trial, just the same as the complainants have taken from the files all the defendants' exhibits filed herein, concerning which Mr. Forbes has testified, and to overturn which he has attempted by the introduction of these exhibits.

Counsel for complainants objects to any witnesses in the shape of valves going into the possession of the defendants until they have given their testimony in the presence of the master. He says: "I took the defendants' exhibits from the files after they had closed their case. I have not closed my case concerning these exhibits. When I have, the defendants may have them."

Defendants' counsel says that he has no desire to take these exhibits until the complainants are through with them.

MASTER: I have, on page 403, expressed my opinion that it is not advisable for me in this case to witness experiments with the valves which have been put in evidence before me unless such experi-
422 ments are made upon the consent of counsel for both parties. I believe I shall be able to make the necessary findings in this accounting upon the evidence which the counsel have already

submitted or shall submit before closing the hearing. If, however, I find it necessary to witness experiments or to make them myself with the valves in evidence before I can make the necessary findings, I have the power to do or to cause to be done whatever may be necessary in this regard, and shall exercise it. If the contention of the plaintiffs on pages 321 and 398 is correct, the behavior of the Webster valves under steam pressure is immaterial to be considered. I will leave the parties to offer such evidence as they may be advised they ought to offer, and will not, as the case is developed at present, witness any experiments which cannot be readily reproduced before the court, should there be a review of my findings by the court, unless both parties consent to experiments being made before me.

(Adjourned.)

MAY 25, 1887.

Complainants' counsel moves that the examination be adjourned to Bridgeport, Conn., to take the evidence of I. W. Gillies, in the testing-room of the complainants, as to the behavior of the various exhibits introduced by defendants and by the complainants in this hearing.

Counsel for complainants says: "Gillies is the valve-tester. I propose he shall be sworn; shall, in answer to questions, put the valves on the boiler, cause them to blow and close under influence of steam only, and then describe in words the thing which has happened in presence of the master. Unless this evidence can be introduced in this way it will be useless to introduce it at all, being a commentary without a text."

MASTER: I deny this motion of complainants' counsel to adjourn to Bridgeport, Conn., to receive the testimony of Mr. Gillies in connection with experiments to be performed by him in my presence. I do not think I ought, in the present state of this case, to witness experiments which cannot be readily reproduced before the court except upon the consent of both parties. I do not understand the difficulty which counsel for complainants appears to have in this matter.

The behavior under steam pressure of the valves introduced
423 in evidence in this case can be very readily shown in the presence of some one accustomed to witness experiments and to observe the conditions under which they are performed and able to describe intelligently what he has seen. Such a person, having witnessed the necessary experiments or having performed them himself or caused them to be performed, could have, in my judgment, no difficulty in testifying as to the action of each of these valves, so that I could understand that action and could report it to the court, if necessary. It would be advisable, I think, to give the adverse party an opportunity to be present at the experiments concerning which it might be proposed to examine a witness. The operation of a particular valve under steam pressure seems to me to be a simple matter to observe and note, and I do not think it would be difficult to remove all chance for an honest conflict of evidence with regard to a special test of a particular valve. If such conflict

should arise, and I should consider it necessary to make a finding as to the action of any particular valve in evidence, and should be in doubt upon the evidence then before me as to what that evidence showed, and should be unable to say what the action of such valve must be upon an inspection of the valve itself, I have full power to make or cause to be made all necessary experiments with the exhibits in my possession to enable me to reach conclusions satisfactory to myself and to report them in an intelligible form to the court. At present I do not believe that counsel will have any difficulty in introducing the necessary evidence, in connection with the exhibit valves, to enable me to understand the behavior of each of them under steam, so far as that behavior is material to the issues upon this accounting.

Complainants object to and except to the ruling of the master refusing to see the operation of the valves, introduced by defendants and by Forbes, under steam.

Complainants move to strike out all defendants' testimony relative to the behavior of any valves under steam which have not been exhibited to the master actually under steam.

MASTER: The evidence covered by this motion has been introduced subject to my determination in my draft and final reports as to its materiality, competency, and relevancy. In my judgment, if it is material to me to determine the behavior of any of these
424 valve exhibits under steam, I may do so in three ways: First, by an inspection of the valves themselves and a consideration of the laws governing the action of steam under pressure and in motion; second, by considering the testimony of persons who have witnessed the behavior of these valves under steam pressure; and third, by performing myself experiments with these valves or witnessing experiments performed by others. I have already decided not to witness experiments performed by others with these valve exhibits in the present condition of this case. I am now requested to strike out the second class of evidence to which I have referred, namely, the testimony of persons who have seen these valves in action under steam pressure. It is possible that all this evidence or some portions of it may be immaterial, because the behavior of certain of the valves under steam pressure may be immaterial, and I reserve the consideration of that matter to my draft and final reports. I decline now to strike out the evidence as requested upon the ground merely, as I understand the request, that I cannot receive testimony as to the action under steam of these valve exhibits unless I have witnessed or shall witness that action myself.

(Adjourned.)

JUNE 4, 1887.

Complainants' counsel objects to the reservation by the master of the questions of admissibility of evidence reserved by him till the draft report. Any such reservation, made against the objection of complainants, is unfair, unless the complainants are allowed, after

the draft report containing the ruling, to introduce evidence bearing on the point to which the evidence objected to is directed.

This reservation embarrasses complainants in presenting their case, and complainants cannot fairly present their cases unless the questions reserved are now decided.

MASTER: I have not intended to make reservations in my rulings which should embarrass counsel in putting in evidence. My principal object in making reservations has been to enable counsel to present the evidence on the issues before me so as to meet any view I might take when the evidence should be closed, and to provide for alternate findings to meet the case where I might consider the law doubtful, or counsel on the one side or the other might con-
425 tend for a different construction of the law from that which I had adopted. This course I have believed would facilitate the putting in of evidence before me, and prevent the necessity of a recommitment of this case to me or to some other master if the court should not confirm my principal findings. This course has been adopted, as I have understood it, with the assent of counsel for both parties, as being most convenient and possibly most economical, considering the positions contended for by counsel before me and the uncertainty of the view which the court may take as to these contentions. I do not understand counsel for complainants to insist that the evidence of Hoadley and Harrison as to the action of certain valves, concerning which they testified, shall be now stricken out or now decided to be immaterial and incompetent, provided complainants are permitted to show the action of these valves under steam pressure in my presence. This I have decided not to permit in the present condition of this case. At the same time it is open to complainants to prove the action of these valves under steam pressure in the manner in which such proof is usually made—that is, by the examination of persons accustomed to witness experiments with steam apparatus and to observe the conditions under which such experiments are performed, who shall have seen the action of these valves under steam pressure. I do not believe the complainants will have any serious embarrassment in presenting such evidence, if they desire to do so. I do not think it would be right for me now to strike out the evidence of defendants on this subject or to decide it to be inadmissible. As this evidence has gone in *de bene*, the complainants must take the responsibility of meeting it or not, as they may be advised. When the case is submitted to me upon the evidence before me I shall made my draft and final reports upon that evidence unless I shall then see cause to open the case for further evidence. I must decline promising to do so beforehand upon any possible findings I may make.

If counsel for complainants insists upon a ruling now on the admissibility of the evidence of defendants as to the action of the exhibit valves under steam I will make a ruling admitting all the evidence on that subject which is now objected to by him. I do
426 not think I should be so free to deal with this whole subject after such a ruling as I should be if I were permitted to re-

serve my ruling in this regard to my draft report, and complainants should put in their evidence *de bene* as to the action of the exhibit valves under steam pressure.

(Adjourned.)

JUNE 10, 1887.

Mr. CLARKE: Counsel for complainants now excepts to the ruling that any evidence is admissible before the master as to the behavior under steam of any so-called Webster valves which are not in evidence in the principal case; second, that any evidence is relevant or competent in this hearing to show that the information given by the Webster patent at the date of the Richardson patents in suit differed in any way from the information which was sworn to and considered by the Supreme Court on the appeal in this cause; third, that any evidence is admissible as to the said Webster patent, or the behavior of valves purporting to be made under it, which was not before the Supreme Court in the principal case; fourth, that the master has admitted evidence of *ex parte* experiments, and excluded evidence of experiments to be conducted in his presence and the presence of the defendants, and insists that all tests and trials of the valves in evidence in this case shall be *ex parte* tests and trials, not under the supervision of the master and not in the presence of the opposite party; fifth, that the master refuses to adjourn to Bridgeport to take the evidence of a witness beyond the jurisdiction of the court, and has ruled, refusing the motion to adjourn before evidence is offered, in such a way as to exclude a certain class of evidence, which, until the evidence is offered, cannot be passed upon as relevant or competent; sixth, and further excepts to the refusal of the master to strike out defendants' testimony as to the behavior of the valves under steam, introduced for the first time in this hearing, which have not been exhibited to the master under steam.

Counsel for complainants says: As there seems to be a misunderstanding between complainants' counsel and the master as to the ruling on the adjournment to Bridgeport, moved for May 25, complainants' counsel now moves that the examination be adjourned to Bridgeport, Conn., to take the evidence of J. W. Gillies at the complainants' office as to the behavior of the various exhibits in-
427 troduced by defendants and complainants; said exhibits to be tested, pending the examination, and the evidence concerning them to be given after each test, the defendants and master to be at liberty to see the tests when made and as made, but to be also free to exclude themselves from the chance of acquiring information, if they shall so desire.

MASTER: Mr. Millett, do the defendants consent to the adjournment requested by complainants?

Mr. MILLETT: They do not; and one of the reasons for not consenting is that they do not feel that they should be called upon to incur the expenses of attending the taking of this testimony or of being present at the taking of this testimony.

MASTER: I decline to adjourn this hearing to Bridgeport, Conn., for the purpose stated in the motion of complainants' counsel. I do

not understand that the complainants would have any difficulty in having their valve-tester, Mr. Gillies, or some other competent person perform the tests to which Mr. Clarke alludes in this motion, and then taking his evidence in relation thereto here, where the evidence has so far been taken, and I am unwilling, in the present condition of this case, to be present where tests are being performed with the valve exhibits in this case except by consent of both parties.

Mr. CLARKE: Complainants' counsel renews the fourth and fifth exceptions this day stated.

(Adjourned.)

Further Evidence for Defendants.

Testimony of William H. Harrison.

(Resumed from page 360.)

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Sept.* 14, 1887.

Int. 173. You are the same William H. Harrison who has before testified in this case, pages 315 to 360, are you not?

Ans. I am.

Int. 174. Have you examined and do you understand "Complainants' Exhibit True Representation Richardson Valve from
428 Original Drawing of 1866," and have you obtained the dimensions thereof?

Ans. I have examined and do understand said exhibit, and have obtained the dimensions thereof.

Int. 175. Please give those dimensions, and also the corresponding dimensions which you have obtained heretofore of the safety-valve shown in the original drawing of the Richardson patent of 1866; and, if the same are tabulated, please produce the table as a part of your answer.

Ans. I have tabulated the same and produce the following table showing the dimensions called for:

DIMENSIONS IN INCHES.

	DIAMETERS.					
	Steam-way.	Top of ground joint.	Extended valve seat.	Inside of lip.	Horizontal width of outlet.	Overlap.
Dimensions of tracing forming part of certified copy of Richardson's patent of 1866 (Hoadley's testimony, p. 301, Harrison, p. 319, of Accounting Record)	2.25	2.73	3.228	3.26	$\frac{1}{64}$ or .016	.03
"Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866"	2.25	2.74	3.210	3.268	.029	.02

Int. 176. Have you made any tests of the said complainants' exhibit and examined and measured the springs used by you in those

tests? If so, please describe said springs and give their measurements.

Ans. I have made tests of the valve and have measured the springs which I used in those tests. There were five of them, which are here exhibited.

1. The lever attachment of the Defendants' Exhibit Richardson Valve from Original Drawing, and described by Mr. Hoadley at the foot of page 301, and the spring of No. 6 wire described by me, page 320, and marked "Spring for Richardson valve, of No. 6 wire." The extension of this spring, when strained for 100 lbs. popping pressure, was $1\frac{5}{16}$ inches.

2. The same lever as in previous experiment, using the defendants' No. 7 spring described by me on Record, page 320, and marked "Spring for Richardson valve, of No. 7 wire."

429 3. The direct spring of the complainants here exhibited and marked with four notches. This spring is composed of $6\frac{1}{2}$ turns of steel $\frac{3}{8}$ inch square; the outside diameter is $2\frac{1}{16}$ inches; length when free, 4.06 inches; when compressed for 100 lbs. the length is 3.80 inches; the compression then is .16 inch.

4. The direct spring of the complainants, marked with five notches. This spring is composed of $6\frac{1}{2}$ turns of steels $\frac{3}{8}$ inch square; the outside diameter is $2\frac{3}{16}$ inches; length when free, 4.12 inches; length when compressed for 100 lbs., 3.88 inches; compression, .27 inch.

5. The direct spring of the complainants, marked with six notches, composed of $6\frac{1}{2}$ turns of steel $\frac{7}{32}$ inch square; outside diameter, $2\frac{1}{8}$ inches; length when free, 4.06 inches; length when compressed for 100 lbs., 3.68 inches; compression is .38 inch.

Int. 177. Have you examined and do you understand Complainants' Exhibit Forbes Exhibit Corrected Representation Richardson Valve from Photo-lithograph Drawing, and have you measured same?

Ans. I have examined and measured said exhibit.

Int. 178. Please give the dimensions obtained by you in such measurement and the corresponding dimensions as found by you in your measurement of the drawings of the printed copy of the Richardson patent of 1876, and those also obtained by Charles W. Forbes of the same drawings, as found in the record in the principal case, on pages 332 and 333.

Ans. These dimensions I have tabulated, and I now produce the table as my answer, as follows:

	Dimensions in Inches.					
	Diameters.					
	Steamway.	Top of ground joint.	Extended valve seat.	Inside of lip.	Horizontal width of outlet.	Overlap.
Photolithographic drawing of patent granted to Geo. W. Richardson Sept. 25, 1866 (Forbes' testimony, pages 332 and 333, Record in principal case; Hoadley, pages 298 and 299; Harrison, page 316, of Accounting Record)--	1.34	1.65	1.94	1.96	.01	.025
Forbes' Exhibit Corrected Representation from Photo-lithographic Drawing.	1.34	1.65	1.94	1.968	.014	.009

430 Int. 179. As said Forbes has not given the width of the stricture directly, will you please state what the width is as ascertained from the dimensions spoken of as his in the previous question?

Ans. .01 inch. I find on page 333 of principal record a dimension given as "Average circumference of space between extended valve head and edge of lip *c*, inches, 6.126." The diameter of this circumference is 1.95 inches. I also find, page 332, the statement, "Diameter valve inside the lip forming the stricture, inches, 1.96." Now, if the average diameter is 1.95 inches and the greater diameter is 1.96 inches, the less diameter, which is the diameter of the extended valve-seat, must be 1.94 inches, and the difference between 1.94 inches and 1.96 inches is .02 inch, and one-half of this difference is the horizontal width of the outlet or stricture, and is .01 inch.

Int. 180. Have you made any tests of said complainants' exhibit; and, if so, have you examined and measured the springs used by you in such tests? If so, give your measurements.

Ans. I have tested said exhibit, using five different direct springs, which are here exhibited.

1. The defendants' spring, marked "Richardson spring, 80 to 100 lbs., weak spring," the dimensions of which I gave on page 317. I find, however, that since I testified this spring has taken a permanent set, and the length when free is now 2.65 inches, and, when compressed for 100 lbs. working pressure on this valve, the length is 2.35 inches, a compressure of .30 inch.

2. The spring marked "Richardson spring, 100 to 125 pounds, ordinary spring," the dimensions of which I gave on page 318. The compression at working pressure of 100 pounds is .35 inch.

3. The spring marked "Richardson spring, 125 to 140 pounds, strong spring." The dimensions will be found on page 318 of this Record. The compression at 100 pounds is .20 inch.

4. The spring marked "Forbes strong Richardson spring, comp. .15 inch for 100 pounds." This spring is composed of $7\frac{1}{4}$ turns of steel, $\frac{1}{4}$ inch square. The outside diameter is $1\frac{5}{16}$ inches; length when free, 2.80 inches; length when compressed for 100 pounds, 2.70 inches; compression is, therefore, .10 inch.

5. The spring marked "Rich. ordinary spring, comp. .25 inch for 100 pounds." This spring is composed of $8\frac{1}{2}$ turns of steel,

431 $\frac{7}{32}$ inch square. The outside diameter is $1\frac{3}{8}$ inches; length when free, 3.28 inches; compressed for working pressure of 100 pounds, 3.03 inches. The compression is .25 inch.

Int. 181. Please give the results of your tests of the said complainants' exhibits testified of by you, showing the lift of valve when blowing under each spring used, the opening and closing point, and the amount of loss of steam in pounds pressure by such valve; also the areas of the openings in such valve when blowing, both at the ground joint and at the outlet of the lip, with the ratio of such openings.

Ans. I have tabulated the results of my experiments, and also the results of my calculations as to areas of openings, and I now present the table as my answer, as follows:

"FORBES EXHIBIT CORRECTED REPRESENTATION RICHARDSON VALVE FROM PHOTO-LITHOGRAPHIC DRAWING."

SPRINGS.	INCHES.		AREAS OF OPENINGS IN SQUARE INCHES.			STEAM PRESSURE IN BOILER IN POUNDS PER SQUARE INCH.		
	Compression of spring at 100.	Lift of valve.	At ground joint.	At outlet.	Ratio of ground joint to outlet.	Opened.	Closed.	Reduc.
"Forbes strong Richardson spring"	.10	.02	.0729	.1105	1 to 1.51	100	95½	4½
"Richardson spring, 125 to 140 pounds; strong"	.20	.025	.0909	.1305	1 to 1.44	100	95	5
"Richardson spring, 100 to 125 pounds; ordinary spring"	.35	.03	.1089	.1547	1 to 1.42	100	95	5
"Richardson ordinary spring; comp., .25 inch for 100 lbs."	.25	.04	.1448	.2087	1 to 1.44	100	95	5
"Richardson spring, 80 to 100 pounds; weak spring"	.30	.05	.1804	.2658	1 to 1.47	100	93½	6½

"TRUE REPRESENTATION RICHARDSON VALVE FROM ORIGINAL DRAWING OF 1866."

SPRINGS.								
Complainants' spring; mark, 4 notches	.16	.03	.1967	.3114	1 to 1.58	100	96	4
Defendants' lever with defendants' No. 6; extension; $\frac{5}{8}$		.033	.2163	.3236	1 to 1.50	100	95	5
Complainants' direct spring; mark, 5 notches	.27	.04	.2618	.3584	1 to 1.37	100	94½	5½
Defendants' lever with No. 7 spring; extension; .2$\frac{5}{8}$		.047	.3072	.4030	1 to 1.31	100	92	8
Complainants' direct spring; mark, 6 notches	.38	.05	.3267	.4245	1 to 1.30	100	93	7

432 Int. 182. Where were these tests made and who was present with you in making them?

Ans. These tests were made on the large testing boiler of the defendant company. There was present with me Mr. William Burnett.

Int. 183. Whether or not it was the same boiler used by you in your tests of the defendants' exhibits already testified of as made by you, and what was its condition as compared with its condition at those tests?

Ans. It was the same boiler and the conditions were alike.

Int. 184. What was the action of the Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866?

Ans. When using the defendants' lever and springs, Nos. 6 and 7, the action was good. When using the complainants' direct spring, marked with four notches, the lift of the valve was small—only .03 inch, as shown in the table; the valve was also difficult to adjust to popping pressure on account of the uncertainty of its action. With the defendants' direct springs, marked with five notches and with six notches, the action was good.

Int. 185. Have you examined and applied, both to Defendants' Exhibit Richardson Valve from Original Drawing and the Richard-

son Drawings of the Richardson Patent of 1866, which represent said exhibit, the Complainants' Exhibit Forbes Templet of Defendants' Exhibit Richardson Valve from Original Drawing? If so, please state whether or not there is anything in such templet which discloses any departure of Defendants' Exhibit Valve, in its construction, from said Richardson drawing.

Ans. I have applied said templet to the said defendants' exhibit, and I have applied the templet to the drawing. I find that the templet discloses no departure whatever from the drawing of the Richardson patent of 1866.

Int. 186. Please state what Fig. 3 of the drawing of the Richardson patent of 1866 represents.

Ans. The patent says: "Fig. 3 is a vertical section at *x x*, Fig. 1, of the valve and seat in position."

433 Int. 187. Does it give the true relation of the parts of a whole safety-valve such as is described in the patent specification?

Ans. It does.

Int. 188. Have you examined and applied to the drawings of the Richardson patent of 1866, Complainants' Exhibit Forbes Templet Richardson 1866 patent? This templet has stamped upon it "J. W. Gillies, Fig. 4, 1866."

Ans. I have.

Int. 189. In your application of the two templets testified of to Fig. 3, making the lines representing the ground joint and the chamber D of the templet conform to the corresponding lines shown in Fig. 3 of the drawings, which of said templets the better represents said drawing, Fig. 3?

Ans. The templet marked "Forbes Templet of Defendants' Exhibit Richardson Valve from Original Drawing."

Int. 190. Have you applied the Forbes templet stamped "J. W. Gillies, Fig. 4, 1866," to the valve of the complainants' exhibit in the way testified of by Mr. Forbes in his deposition—that is, so that the edge of the templet shall rest upon the guide wing of the valve?

Ans. I have.

Int. 191. In such application, how do the lines of the templet, representing the lines of Fig. 4, as testified of by Mr. Forbes, conform to the corresponding lines of the valve of the exhibit?

Ans. I find that the templet applied to Fig. 4 fits its lines with tolerable accuracy. On applying the same templet to the valve I find that the inner wall of the circumferential chamber does not quite touch the templet, and therefore that said circumferential chamber is slighly wider than the drawing.

Int. 192. While said templet may disclose the diameter of the lip of the valve, is there anything in it which discloses the diameter of the extended seating of the valve, unless it be this want of contact just spoken of, which suggests that the extended valve seat may be reduced in width?

Ans. There is nothing.

Int. 193. As a fact obtained by your measurements, is not the extended valve seat of less diameter than the diameter of the

434 extended valve seat as shown in the original drawings; and, if so, how much?

Ans. It is of less diameter by .018 inch.

Int. 194. What width of stricture did you find in this exhibit?

Ans. .029 inch.

Int. 195. What does that width include, considering the variations existing between the dimensions of the original drawing and the corresponding dimensions of this exhibit?

Ans. It includes an increase of width radially outward and an increase of width radially inward, together with the horizontal outlet, as shown in the drawing.

Int. 196. What are those widths in figures?

Aus. The radial extension outwad is .004 inch; the radial extension inward is .009 inch, and the stricture shown in the drawing is .016 inch or $\frac{1}{64}$ inch. The sum of these is .029 inch.

Int. 197. And by actual measurement of the diameter of lip and of the diameter of the extended valve seat you found that one-half of the difference gave this width for the stricture. Is that so?

Aus. It is.

Int. 198. What was the overlap of this complainants' exhibit and how much did it differ from that shown in the original drawing?

Ans. The overlap of this exhibit is .02 inch, and is .01 inch less than tha overlap shown in the drawing.

Int. 199. Where did you find the top of the actual ground joint in this exhibit?

Ans. Half way down the bevel, which was turned out to make the ground joint.

Int. 200. What is the diameter at that point of the valve seat?

Ans. 2.5 inches.

Int. 201. Between that upper edge of the ground joint and the upper edge of the continuation of the bevel, is there a space or not?

Ans. There is a narrow space.

Int. 202. In computing the area of the opening at the ground joint of this exhibit for comparison with the opening at the lip of the valve, at what point did you assume to be the edge of the ground joint for making the calculation?

435 Ans. I assumed the edge of the ground joint to be at the top of the bevel.

Int. 203. Is the diameter at that point more or less than that shown in the drawing?

Ans. More.

Int. 204. So that a computation so made would be more favorable in the ratio of areas of openings than of any made upon the diameter given by the patent, would it not?

Ans. Yes, sir.

Int. 205. Assuming that this exhibit had the outlet at the lip which constitutes what is called the stricture $\frac{1}{64}$ of an inch in width, and not .029 inch, as shown in the exhibit, and had the overlap of the lip .03 inch and not .02, as shown in the exhibit, what would have been the lift of such valve in operation, using the same springs

which you used in the tests of said exhibit testified of by you—that is, would it have been greater or less than in those tests?

Ans. The lift would have been greater.

Int. 206. In such modified valve, what would have been the loss of steam when in operation?

Ans. The loss of steam from a boiler using the valve with the $\frac{1}{64}$-inch outlet and the .03-inch overlap would have been very much greater.

Int. 207. What would have been the relation or ratio of the openings of such modified valve under operation at the ground joint and at the outlet of the lip?

Ans. In the valve having the $\frac{1}{64}$-inch outlet and the .03-inch overlap, the area of the outlet would be less than the area of the opening at the ground joint.

Int. 208. Which of the two valves would conform to the description of the safety-valve given in the Richardson patent of 1866?

Ans. The assumed valve with $\frac{1}{64}$-inch outlet and .03-inch overlap.

Int. 209. In what respect does the exhibit differ from the valve described in the patent?

Ans. It differs, from the fact that it has a width of outlet nearly double that shown in the patent, and an overlap only two-thirds of that shown in the patent.

436 Int. 210. Do these differences materially change it from the valve described in the patent; and, if so, why?

Ans. They do materially change it; they materially change the action of the valve, causing it to take out very much less steam from the boiler than a valve would do if made strictly to the patent.

Int. 211. Why is there less loss of steam in operation?

Ans. Because the valve of the Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866 at all times has a larger area of opening from the circumferential chamber to the atmosphere than the area of the opening at the ground joint leading into the circumferential chamber.

Int. 212. Does this exhibit, then, so constructed and so operating, conform to the valve described in the patent of 1866?

Ans. It does not.

Int. 213. Have you examined Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing with reference to what Mr. Forbes called "a circumferential ledge"? And, if so, was any such obstruction found in any way materially or otherwise affecting the operation of a valve made in accordance with the photo-lithograph drawing of the Richardson patent of 1866, or modifying the material dimensions of such valve and drawing?

Ans. I have examined said exhibit and find no obstruction or modification.

Int. 214. What was the apparent cause of what he called "a circumferential ledge"?

Ans. A slight difference between the angles of the valve seat and the conical surface of the valve, which is made apparent by grinding.

Int. 215. And this difference did not change the height or the

width of the supplementary chamber, or the width of the stricture, or the overlap of the lip of the valve, did it?

Ans. No, sir.

Int. 216. In Complainants' Exhibit Forbes Exhibit Corrected Representation Richardson Valve Photo-lithograph Drawing, how does the width of the stricture and the overlap of the lip compare with the width of the same parts of the drawing from which it purports to have been made?

437 Ans. I find in the drawing the horizontal width of stricture is .01 inch; in the exhibit it is .014 inch; the overlap in the photo-lithograph drawing I find it to be .025 inch, and the same dimensions in the exhibit is .009 inch.

Int. 217. How do these dimensions in the exhibit change the openings at the ground joint and at the lip from those which you have found to exist in the defendants' valve made like the drawing?

Ans. In the complainants' valve the area of the outlet from the circumferential chamber is always larger than the area of opening at the ground joint, and in a valve made according to the drawing the area of the outlet from the circumferential chamber will be less than the area of the opening at the ground joint into that circumferential chamber.

Cross-examination *de bene* by Mr. CLARKE:

Cross-int. 218. From what figure of the tracing of the drawing of the Richardson patent of 1866 were the measurements taken which you give in answer to Int. 175?

Ans. Fig. 3 and Fig. 1.

Cross-int. 219. Do the measurements of Fig. 3 and Fig. 1 correspond?

Ans. I do not know.

Cross-int. 220. If you measured them both, why is it that you do not know?

Ans. I did not measure them both.

Cross-int. 221. Which one did you measure?

Ans. Fig. 3.

Cross-int. 222. Then the measurements given in your answer are not the measurements, so far as you know, of Fig. 1?

Ans. I know nothing about the dimensions of Fig. 1. The only information I obtained from Fig. 1 was the form of the valve.

Cross-int. 223. From what figure of the photo-lithographic drawing of the patent granted to George W. Richardson Sept. 25, 1866, were the measurements taken which you have given in answer to Int. 178?

Ans. Fig. 3.

Cross-int. 224. At what temperature did you measure the

438 lengths of springs concerning which you have testified in answer to Ints. 176 and 180?

Ans. A temperature, I should judge, somewhere between 80° and 200° Fahrenheit.

Cross-int. 225. They were on valves when you measured them?

Ans. When I measured them for compression they were.

Cross-int. 226. And had you blowed the valve and observed the

gauge so that you are able to say that the valve opened at one hundred pounds working pressure in each instance?

Ans. Yes, sir.

Cross-int. 227. Where was your gauge attached, to the boiler or to some of the testing apparatus to which the gauge was mounted?

Ans. The gauge was mounted on the side of the building and connected by a suitable pipe of no great length directly with the upper part of the boiler.

Cross-int. 228. At what point in the opening of the valve was the area of opening at the ground joint calculated, and from what factors, which you have given in answer to Int. 181.

Ans. The points at which they were calculated were the extreme lifts of the valves as shown in the different experiments.

(Adjourned.)

SEPT. 15, 1887.

(Witness continues:)

To calculate the areas of the outlets, if I understand the question aright, from the diameter at the top of the bevel of the ground joint, I subtracted an amount equal to half the lift of the valve as obtained in each experiment. Using this reduced diameter, I calculated the circumference which is the average for the outlet. The width of the opening at the ground joint is equal to the lift of the valve multiplied by the natural sine of the angle which the bevel of the ground joint makes with the perpendicular. This angle in Forbes' Exhibit Corrected Representation Richardson Valve from Photo-lithograph Drawing and in Defendants' Exhibit Richardson Valve Like Photo-lithograph Drawing is 45° from the perpendicular, and the natural sine of 45° is .707. The angle in Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866 and Defendants' Exhibit Richardson Valve from Original Drawing is 50° from the perpendicular, and the natural sine of an angle of 50° is .766. The area of the opening is equal to the average circumference multiplied by the width of the opening. This method of calculation is the same as that which I gave on pages 339 and 340.

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Cross-int. 229. Why did you subtract half the lift of the valve from the diameter of the top of the bevel of the ground joint to get the average for the outlet rather than any other fraction of the lift of the valve?

Ans. I do not think that the record will show that I used exactly that language.

Cross-int. 230. Why did you take the diameter of the top of the bevel of the ground joint as your minuend rather than the diameter of the bottom of the ground joint as your minuend?

Ans. It was because I wished to calculate the area of the opening from the ground joint into the circumferential chamber.

Cross-int. 231. Whereabouts in the Richardson patent of 1886 do you find any instructions to make any such calculation in order to determine anything.

Ans. I don't remember any instructions for making calculations.

Cross-int. 232. Whereabouts in the Richardson patent of 1866 do you find any language which leads you to imagine that either of the calculations which you have given in answer to Int. 181, under the head of areas of openings in square inches, are in — way material to the present contention?

Ans. I find nothing, because the Richardson patent was written twenty-one years ago, and a long time previous to the present contention.

(Motion to strike out "because" and all after it.)

Cross-int. 233. Whereabouts, in any patents or instructions of George W. Richardson as to the making of safety-valves, do you find any instruction to take for comparison with the area of opening into the atmosphere at the stricture the area of opening into the huddling chamber at the outer edge or near the outer edge of the bevel of the ground joint? Please state where you find the instruction and the language in which it is given.

Ans. There are no such instructions in the specification of the patent of Sept. 25, 1866, but I do find in the specification of
440 the patent granted to George William Richardson, of Troy, N. Y., Jan. 18, 1869, page 18 of principal record, the following language:

"My said invention relates to improvements in the invention described in letters patent granted to me and bearing date the twenty-fifth day of September, 1866, which said patented invention relates to a means for providing a more free escape for the steam than could be obtained by safety-valves as constructed prior thereto and to insure the keeping of the valve open until the pressure of the steam in the boiler or generator falls below the pressure which was required to open it, the said means so patented consisting in forming the valve with a surface outside the ground joint for the escaping steam to act against, the said surface being surrounded by a projecting or overlapping lip, rim, or flange, leaving a narrow space for the escape of the steam when the valve is opened, but which, although of greater diameter than the valve seat, by reason of the said lap, presents a less area of opening for the escape of steam than is produced at the valve seat."

I wish to explain my answer to cross-int. 229 a little further: The language which I used was, "from the diameter of the bevel at the top of the ground joint I substracted an amount equal to one-half the lift." I used that expression in place of the expression "substract half the lift of the valve" because, to my mind, it seemed to be more mathematically correct. I have made a little geometrical construction, which shows the reason why the average diameter is less than the diameter at the top of the bevel of the ground joint by an amount equal to half the lift, and that construction I might describe. From the point which forms the top of the bevel of the ground joint draw a line at right angles to the conical surface of the valve, and terminated by that conical surface. Now, let a vertical line be drawn through the centre of the line first drawn, terminated at its upper extremity by the face of the valve and its lower

extremity by the face of the seat, and the length of this line will represent the lift of the valve, and this line will be divided in two equal parts by the intersection of the first line. Now, if a horizontal line be drawn from the point representing the top of the bevel of the seat falling perpendicularly upon the vertical line, the lower half of that vertical line will again be bisected and the short horizontal line will be equal to one-fourth of the vertical line, and this short horizontal line multiplied by 2 shows the amount which
441 the diameter at the top of bevel of ground joint is to be shortened to obtain the average diameter which I used in making my calculation for the areas of the outlets.

Cross-int. 234. The words "valve seat" in the phrase "greater diameter than the valve seat" and in the phrase "is produced at the valve seat," which you have quoted above, you take to mean ground joint, do you not?

Ans. Yes.

Cross-int. 235. Please now turn to the Richardson patent of 1866 and tell me whether, in your judgment, the words "valve seat" in the phrase "*c c* is a circular or annular flange or lip extending over, slightly below, and fitting loosely around the outer edge of the valve seat E E" means the ground joint of the valve therein referred to, and nothing but the ground joint.

Ans. It does not mean the ground joint, because the ground joint is referred to further on in the same paragraph by the statement "F F is the ground joint of the valve and seat."

(Adjourned.)

OCT. 3, 1887.

Cross-int. 236. Why, then, if the "valve seat" of the patent of 1866 does not mean the ground joint, did you take the area of opening at the edge of the ground joint as the area of opening which is produced at the valve seat to compare with the area of opening at the outer edge of the valve seat and between it and the overlapping lip, rim, or flange, instead of the greatest area of opening which can be found between the valve seat marked "E E" in the Richardson drawings of 1866 and the lower surface of the extended valve head vertically over this valve seat E E?

(Objected to, as it is the merest assumption and not a statement of fact that the valve seat of the patent of 1866 does not mean the ground joint broadly, because the patent itself says, "The nature of my invention consists in increasing the area of the head of the common safety-valve outside of its ground joint" of such form that the steam shall act with greater force upon it "after it has lifted the valve from its seat at the ground joint.")

Ans. I took the area of the opening at the edge of the
442 ground joint for comparison with the area of the opening at the outer edge of the valve seat because the edge of the ground joint is the only place at which an opening exists from the ground joint into the circumferential or annular chamber, and because the vertical measurement assumed for comparison in the ques-

tion between the valve seat marked "E E" and the lower surface of the extended valve head is not the measurement at all of the width of an outlet, but it is merely the height of the circular or annular chamber itself, in which, to quote from the Richardson patent of 1866, "the steam escaping in the direction indicated by the arrows in Fig. 3 first lifts the valve from its seat at the ground joint F F, and then, passing into the annular chamber D D, acts against the increased surface of the valve head, and by this means, together with its reaction produced by its being thrown downwards upon the valve seat E E" (and E E in this connection I interpret to mean the valve-seat casting), "it overcomes the rapidly increasing resistance of the spring or balance, lifts the valve still higher, and escapes freely into the open air."

Cross-int. 237. Had you taken the area of opening at the extreme lift of the valve at the inner edge of the ground joint instead of at the outer edge of the ground joint, would not the figures of the table on page 431 and of all the other tables in which you give the area of opening at the ground joint have been reduced in the ratio represented by the diameters of the ground joint at its top and at its bottom?

Ans. I think they would; and in that case the ratio of the area of the ground joint to the outlet openings would have been larger even than they now are.

Cross-int. 238. In calculating the pressures which govern the action of these automatic valves, do you consider any pressures of material importance except the pressure in the steamway, the atmospheric pressure, and the pressure in the huddling chamber?

Ans. I have never calculated the pressures which govern the action of these automatic valves. I presume I do not understand the question.

Cross-int. 239. In considering the actions of these automatic valves against the stress of a spring tending to keep them closed, are there any lifting pressures or resistances which produce lifting
443 pressures of any considerable importance, except the pressure in the steamway, the pressure in the huddling chamber, and the atmospheric resistance?

Ans. The only lifting pressures which I think of at this time are the steam pressure above the atmosphere in the steamway and the steam pressure above the atmosphere in the huddling chamber. I do not understaud that the atmospheric resistance gives any help towards raising the valve.

Cross-int. 240. Does not all the steam which escapes from the steamway in the Richardson valve escape through the huddling chamber?

Ans. In the Richardson valve patented Sept. 25, 1866, it does, but in the Richardson patent of Jan. 19, 1869, there is an additional outlet to be used, when required, between the disk *f* and the upper edge of the adjustable ring *u*, and the operation of this is described in the following language:

"The difference between the pressure against which the valve will close and the pressure by which it will be opened will depend upon

the distance between the outer periphery of the flange *n* of the cap plate and the inner periphery of the projecting rim *q*. To render this adjustable, the area of the aperture for the escape of steam beyond the valve seat must be adjustable. This is effected by the raising or lowering of the ring *u*. If it be set to its lowest position, the steam escaping from the valve will be free to escape between the top of the valve and the cap through the central aperture, and thence between the upper edge of the ring *u* and the disk *f*, without materially aiding to lift or hold up the valve; but by setting the ring *u* nearer to the under surface of the disk *f*, and thereby reducing the space for the escape of steam, it will be caused to act by its elastic force against the annular space *o* of the cap plate, and thus assist in lifting the valve and holding it up."

Cross-int. 241. Turning now to the certified copy, Richardson's 1866 drawing, is the diagram marked "Fig. 1" a plan of the thing of which the diagram marked "Fig. 3" indicates a vertical section?

Ans. It is what we as draughtsmen sometimes term an inverted plan—that is, a bottom view of the two things shown as assembled together in Fig. 3, and is a true representation, so far as can be shown in such inverted plan.

Cross-int. 242. And when Fig. 3 shows the two things as-
444 sembled together, does it show them in elevation, section, or perspective?

Ans. Fig. 3 shows a vertical section through the vertical axis of the valve and valve-seat casting.

Cross-int. 243. Now, do the diameters of the inner edge of the ground joint, of the outer edge of the ground joint, of the outer edge of the valve seat E E, and the inner edge of the lip *c* correspond in the plan, Fig. 1, and section, Fig. 3?

Ans. They do correspond, according to the rules of descriptive geometry for delineating such magnitudes.

Cross-int. 244. According to the rules of descriptive geometry for delineating such magnitudes, do the diameters of the inner lower edge of the lip *c* and the point of junction between the curved line of the huddling chamber and the line of the ground joint in Figs. 3 and 4 correspond?

Ans. According to the rules of descriptive geometry, Figs. 3 and 4 have no relation to each other. Fig. 4 is delineated as a different magnitude, which may or may not be similar to the valve head of Fig. 3.

Cross-int. 245. According to the rules of descriptive geometry, does the diameter of the parts inquired of in the last question correspond with the diameter of similar parts in Fig. 1?

Ans. Under the rules of descriptive geometry, the dimensions of similar parts in Fig. 4 and Fig. 1 may or may not correspond. In point of fact, in this case I believe that they differ somewhat.

Cross-int. 246. Now, in point of fact, do not the dimensions inquired of in cross-int. 243 differ somewhat in the Figs. 1 and 3?

Ans. I believe not.

Cross-int. 247. In point of fact, the plan view of Fig. 2 represents a part of the thing shown in the plan view of Fig. 1, does it not?

Ans. It represents a part of the plan view of one of the things shown in Fig. 1.

Cross-int. 248. In point of fact, do not the dimensions of that one of the things shown in Fig. 1 which are represented in Fig. 2 correspond?

Ans. The question has become so involved that I don't understand it.

445 Cross-int. 249. In point of fact, do you understand what part of one of the things shown in Fig. 1 is shown in Fig. 2?

Ans. The thing shown in Fig. 1 which is also shown in Fig. 2 is the end view of the valve head as seen from the bottom. The valve-seat casting in Fig. 1 interfering between the eye of the observer and the valve head, Fig. 2 shows more clearly the general form of the valve head.

Cross-int. 250. Do the diameters of the circles in Fig. 2, which represent the same things which are represented by the full-line circles in Fig. 1, correspond to the diameter of the full-line circles of Fig. 1, respectively, leaving out of consideration the third full-line circle in Fig. 1, counting from the exterior of said figure? Please answer this question in point of fact as well as in point of the rules of descriptive geometry.

Ans. I do not now remember, but my impression is that the circles referred to in the question do not exactly correspond.

Cross-int. 251. Will you ascertain the fact inquired of in this question?

Ans. In what way?

Cross-int. 252. In some similar way to that in which you ascertained the dimensions in inches of the various diameters concerning which you have testified on pages 428 and 429, and with somewhat similar nicety.

Ans. I will, and hand in my answer at a future time.

(Adjourned.)

OCT. 5, 1887.

(Witness continues:)

The diameter of the outside circle in Fig. 1 is 3.45 inches; in Fig. 2 it is 3.47 inches. The diameter of the next circle from the outside in Fig. 1 is 3.29 inches, and in Fig. 2 it is 3.30 inches. These two circles are the boundaries of the lip *c c*. The two inner complete circles of Fig. 2 represent the boundaries of the ground joint, and their diameters are as follows: Inside circle in Fig. 2, diameter is 2.25 inches, and in Fig. 1 it is 2.24 inches. The diameter of the next circle in Fig. 1 is 2.78 inches; and the circle in Fig. 1, which corresponds to this, is a dotted circle of which the diameter is 2.77 inches.

446 *Testimony of William Burnett.*

(Resumed from page 379.)

Direct examination by J. H. MILLETT, Esq., of counsel for defendants:

BOSTON, *Oct.* 3, 1887.

Int. 69. Please state your name, and if you have been previously examined in this case.

Ans. William Burnett; I have testified in this case, and my testimony is printed on pages 360 to 379.

Int. 70. Have you examined and do you understand Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866, and Forbes Exhibit Corrected Representation Richardson Valve from Photo-lithograph Drawing?

Ans. I have examined them and understand them.

Int. 71. Have you made measurements of certain parts and openings of said exhibits obtaining dimensions? If so, please compare with your minutes the dimensions given of the first of said exhibits by Harrison in his answer to Int. 175, Record, page 428; also his dimensions given in answer to Int. 178, Record, page 429, of the second of said exhibits.

Ans. I have examined them, and find them to correspond in measurements with my own minutes of the examination made Aug. 30 and 31, 1887.

Int. 72. Have you made any tests of said exhibits with various springs? If so, where, and who was associated with you, if any one, in making such tests?

Ans. I made a number of such tests at the works of the Crosby Steam Gage and Valve Company, the thirty-first day of August, in company with Mr. Harrison. Five tests of each valve were made with different controlling springs.

Int. 73. Please examine the table of tests, showing the tests of the two exhibits mentioned in Int. 70, the compression of the springs, the lift of the valves, the area of openings at ground joint and outlet, and the ratio of such openings of each of said exhibits with the various springs used, as given by Mr. Harrison in his answer

447 to Int. 181, Record, page 431, and state how they compare with your minutes made of such tests and your computations made on their account.

Ans. I have examined the figures in the table and compared them with my notes taken at the time, and I had previously examined the table fully with Mr. Harrison, finding it correct.

Int. 74. Please compare Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866 with the safety-valve described in the Richardson patent of 1866, particularly as to the dimensions of the stricture, and the overlap of the lip, and state whether or not such exhibit differs from said described safety-valve; and, if so, wherein. You may assume the dimensions given on Record, page 301, by Mr. Hoadley, of the patent drawing, and by

Mr. Harrison on page 319, to be the correct measurements of the Richardson drawing.

Ans. Assuming the dimensions given by Mr. Hoadley to be correct, I find a number of important deviations from those measurements in complainants' exhibit referred to, as given by Mr. Forbes. These deviations are as follows:

HOADLEY.	*Inches.*	FORBES.	*Inches.*
Diameter of steamway	2.25	Diameter of steamway	2.25
Diameter of valve inside lip	3.260	Diameter of valve inside lip	3.268
Diameter extended valve seat	3.228	Diameter extended valve seat	3.21
Overlap of lip	0.030	Overlap of lip	0.02
Width of stricture	0.016	Width of stricture	0.029
Diameter top ground joint (supplied by Harrison)	2.74	Diameter top ground joint	2.74

This statement shows several important deviations in measurement, viz.:

1. To the diameter of the valve inside the lip, Forbes adds .008 to the measurement found by Hoadley.

2. From the diameter of the extended valve seat, Forbes takes .018 from the measurement found by Hoadley.

3. This materially affects the horizontal width of the stricture. Hoadley found the width to be but .016, but Forbes makes it .029, or about 81 per cent. greater than the width found by Hoadley.

448 4. Hoadley makes the overlap of the valve lip .03, while Forbes makes it but .02, or one-third less than found by Hoadley.

Int. 75. What is the effect of such variations mentioned by you, in making the openings at the ground joint and outlet from the chamber in said exhibit, when it is lifted in the act of blowing?

Ans. The valve will not rise so high from its seat and it will not blow the steam down so much before closing.

Int. 76. In such case, how do the two openings substantially compare as to area?

Ans. The area of the ground joint in its relation to the area of the stricture at its periphery will be as 1 to 1.50.

Int. 77. Does the Complainants' Exhibit True Representation of Richardson Valve from Original Drawing of 1866, having outlets of the ratio stated, conform to the mechanical description of the safety-valve described in the Richardson patent of 1866, as interpreted by the Supreme Court in this case? And you may refer, if you desire, to the Richardson patent of 1869 to illustrate your opinion.

Ans. It does not conform to the patent, inasmuch as the same requires that the opening produced at the periphery stricture shall always be less, when the valve is opened, than the opening produced at the ground joint.

Cross-examination by Mr. CLARKE:

Cross-int. 78. Please state what the minutes made Aug. 30 and 31, 1887, give you as your own actual result of your own actual measurements of the valves, Complainants' Exhibit True Represen-

tation of Richardson Valve from Original Drawing of 1866 and Forbes Exhibit Correct Representation Richardson Valve from Photo-lithograph Drawing.

Ans. I personally made examination, both of the dimensions of the several parts as also the working of the valves under steam pressure, so as to understand and measure the movements when the valve was lifted.

I obtained by my measures the exact dimensions of all the parts of the valves and casings, taking each dimension personally. I give the measurements from my minutes as follows:

449 COMPLAINANTS' EXHIBIT TRUE REPRESENTATION OF RICHARDSON VALVE FROM ORIGINAL DRAWING OF 1866.

Diameter of steamway	2.25
" top of ground joint	2.74
Angle of seat from perpendicular	50°
Diameter of valve-seat extension	2.21
" inside of lip	3.268
Horizontal opening at lip	.029
Overlap	.02

FORBES EXHIBIT CORRECT REPRESENTATION RICHARDSON VALVE FROM PHOTO-LITHOGRAPH DRAWING.

Diameter of steamway	1.34
" top of ground joint	1.65
Angle of seat from perpendicular	45°
Diameter of valve-seat extension	1.94
" inside of lip	1.968
Horizontal opening at lip	.014
Overlap	.009

Cross-int. 79. You have not measured the drawings of the Richardson patent of 1866, have you?

Ans. No, sir.

Cross-int. 80. Nor the photo-lithographic drawing, have you?

Ans. No, sir.

Cross-int. 81. Where do you find in the Richardson patent of 1866 the statement that there is a ratio of size between the opening at the stricture and at the ground joint?

Ans. I don't find any rule for it in the patent.

Cross-int. 82. In calculating this ratio did you take, as one of the elements for your calculation of the size of opening at ground joint, the circumference or diameter of the top of the ground joint or the circumference or diameter of the top of the steamway?

Ans. The diameter or circumference of the top of the ground joint was employed.

450 Cross-int. 83. In case you took the diameter of the steamway in the drawing and the various other measurements of

the drawings, as you have hitherto taken them, you would not find that the drawing represented a valve in which, at the maximum lift, the area of opening from the steamway into the ground joint was always larger than the area of opening at the stricture, would you?

Ans. I don't know that I would. I am uncertain what the ratio would be.

Direct examination resumed:

Int. 84. In a careful examination of the Richardson 1866 patent, in the light of what the patentee says of that patent in his 1869 patent, and of the interpretation of that 1866 patent by the Supreme Court, what now, in your opinion, is the true locality of the opening into the chamber surrounding the ground joint, with which you may make a comparison of the opening at the stricture or periphery of the valve at the lip?

(Objected to, because a thing which was invented in 1866 cannot be limited or controlled by anything which was said about it in 1869 by the inventor, and question excluded. Defendants except.)

Int. 85. In the Richardson patent of 1866 the patentee says that he has "invented a new and useful improvement on a safety-valve."

In the opinion of the Supreme Court the court say:

"In speaking of the invention of Richardson, as described in his patent of 1866, this court said: 'His invention, as he describes it, consists in increasing the area of the head of the common safety-valve outside of its ground joint, and terminating it in such a way as to form an increased resisting surface against which the steam escaping from the generator shall act with additional force, after lifting the valve from its seat at the ground joint. * * * When the valve opens the steam expands and flows into the annular space around the ground joint.' * * *

Richardson's patent of 1866 states that the addition to the head of the valve terminates in an annular lip * * * forming an annular chamber * * * that the steam, when the valve is lifted, passes beyond the valve seat and into the annular chamber and acts against the increased surface of the valve head. * * *

What was needed was a narrow stricture to hold back the escaping steam and secure its expansive force inside of the lip and thus aid the direct pressure of the steam from the boiler in lifting the valve against the increasing tension of the spring. * * *

451 His patent of 1869 describes the arrangement and operation of the whole apparatus with the adjustable ring thus: When the pressure of the steam lifts the valve the steam acts against the surface of the annular space between the bevel of the valve seat and the downward-projecting flange of the cap plate to assist in holding up the valve against the increasing resistance of the spring. The aperture between the valve and its seat is always greater than that between the flange and the upward-projecting rim, and thus the steam in the annular space assists in holding up the valve till the boiler pressure falls below that at which the valve opened. * * *

In both structures the valve is held to its seat by a spring so compressed as to keep the valve there until the pressure inside of the boiler is sufficient to move the valve against the pressure of the spring, so that the steam escapes through the ground joint into a chamber covered by an extension of the valve. * * *

In the Richardson valve all the steam which escapes into the open air escapes from the huddling chamber through a stricture which is smaller than the aperture at the ground joint."

Now the patentee in his 1866 patent says:

"To the head of the common safety-valve, indicated by all that portion of Fig. 2 lying within the second circle from the common centre, I add what is indicated by all that portion lying outside of the said circle, in about the proportion shown in said figure."

And the patentee points out by another figure, Fig. 4, the division line between the common safety-valve and his device, which he says is an improvement on a safety-valve.

Will you please tell me whereabouts in the Richardson valve, as described, the end of the common safety-valve is and the location of the beginning of the Richardson device is, as stated and shown by him in his specification and drawings?

Also please state what you understand, considered mechanically, to be the point or locality on the ground joint which indicates the inlet into the annular chamber surrounding it and from which may be determined the area of the aperture between the valve and its seat, in the quotations from the opinion of the Supreme Court given.

(Objected to, first, as not opened in cross-examination; second, because the extracts from the opinion of the Supreme Court are not complete paragraphs or sentences, and consequently are garbled and misleading; third, because the interrogative part of the ques-
452 tion, coupled with the introductory part, is grossly leading; fourth, because it is immaterial to any issue at this stage of the cause.

Counsel for defendants says that, on the second point of the objection, he resents the insulting imputation that he has taken extracts for the purpose of misleading any one, and, that there shall be no question of the fairness of his purpose, he requests the master to read the opinion to the witness or to suffer him to read it.

MASTER: The first objection is a technical one and is based upon a rule adopted for the purpose of compelling a party calling a witness to put in all the evidence which he desires from the witness on his first direct examination. This hearing has taken such a range that I should be unwilling to enforce this rule in the present instance if I was satisfied that the objection was well taken. If this evidence is proper to be offered by the defendants I should admit it now, on motion, even if the subject of this inquiry were not opened on cross-examination. In view of the second and third objections, I shall and do direct the witness to consider the Richardson 1866 patent in all its parts and the whole opinion of the Supreme Court in answering the interrogative part of the question.

As to the fourth objection, I do not deem it advisable to pass upon the materiality of the question at the present time, but will reserve my decision thereon to my draft and final reports, as I have certain other questions in the course of this hearing, and will therefore permit the question to be put to the witness and will take his answer thereto *de bene.*

Counsel for complainants excepts to this instruction so far as it directs the witness to consider the Richardson 1869 patent or the opinion of the Supreme Court in relation thereto in his dealing with the Richardson patent of 1866.

Counsel for defendants requests the master to inform the witness that he may consider the 1869 patent, if he desires, in making his answer, whenever the Supreme Court in its opinion has considered the 1869 patent in its interpretation of the 1866 patent, if the master does not understand that this instruction is included in the instruction already given.

MASTER: I have instructed the witness to consider the Richardson 1866 patent in all its parts and the whole opinion of the Su-
453 preme Court in answering the interrogative part of the question, and I will let this instruction stand without further explanation from me. I deem the instruction plain and explicit.

Complainants renew their exception.)

(Adjourned.)

OCT. 12, 1887.

Ans. Richardson says:

"The nature of my invention consists in increasing the area of the head of the common safety-valve outside of its ground joint and terminating it in such a way as to form an increased resisting surface, against which the steam escaping from the generator shall act with additional force after it has lifted the valve from its seat at the ground joint."

That the exact structural relation of the "increased resisting surface" which is added to the head of the common safety-valve may be clearly understood, Richardson says:

"To the head of the common safety-valve, indicated by all that portion of Fig. 2 lying within the second circle from the common centre, I add what is indicated by all that portion lying outside of the said circle, in about the proportions shown in the figure. A transverse vertical section of this added portion is indicated in Fig. 4 by those portions of the figure lying outside of the dotted line *p p, p p*, while all that portion lying within the dotted lines *p p, p p* indicates a transverse vertical section of the common safety-valve alone."

The construction of the common safety-valve being thus clearly defined, by removal of the portions lying outside the dotted lines *p p, p p* its operation would be as follows: When the steam within the boiler reached the pressure for which the valve was loaded the valve would lift from its seat at the ground joint F F, forming an annular outlet, and from the top of this outlet the steam would issue directly into the atmosphere. In the Richardson safety-valves the

discharged steam, instead of issuing directly into the atmosphere, issues first into the circular or annular chamber, D D, where it acts with additional force after it has lifted the valve from its seat at the ground joint.

Replying to the interrogatory more directly, I will say that according to the specification and drawings of Richardson's 1866 patent the common safety-valve ends and the Richardson de-
454 vice begins at the lines *p p*, *p p*, Fig. 4. In the common valve also here the action of the issuing steam ceases and it is blown into the atmosphere, but with the Richardson device it is taken up at this point and, entering the annular chamber D D, is made to perform the duty through its expansive force within the chamber of lifting the valve still higher from its seat at the ground joint.

As to what I understand to be the point or locality on the ground joint which indicates the inlet into the annular chamber surrounding it, I answer: At the top of the ground joint, viz., on the line of its greatest circumference. And from this, the lift of the valve being known, may be determined the area of the aperture between the valve and its seat.

As directed, I have examined the opinion of the Supreme Court in this case with special reference to the subject-matter of this interrogatory, and am satisfied that the views expressed by me on this question are in entire harmony with the opinion of the court. These quotations to which I have referred indicate direct connections between the interior of the annular chamber D D and the opening produced at the top of the ground joint; from the form and arrangement of the parts, it could not well be otherwise.

Cross-examination by Mr. CLARKE:

Cross-int. 86. Will you be kind enough to tell me what Richardson calls in his patent of 1866 the part of his valve structure which makes the floor of the circular or annular chamber D D? And in this connection I call your attention to the printed copy of the Richardson patent in the principal case, page 16, lines 14 to 19:

"*c c* is a circular or annular flange or lip extending over, slightly below, and fitting loosely around the outer edge of the valve seat E E. D D is a circular or annular chamber, into which the steam immediately passes when the valve lifts from its seat at the ground joint F F. E E is the valve seat. F F is the ground joint of the valve and seat."

And I ask you to point out in any portion of that patent any language which would lead you, or even a foolish person, to suppose that the floor of the annular chamber D D was anything else than the upper surface of the valve seat E E.

455 Ans. I don't understand that Richardson in his patent has given any special appellation to the floor of the annular chamber D D, as represented in the drawing, Fig. 3, by a horizontal line connecting the outer edge of the valve seat E E with the top of the valve seat at the ground joint.

The part inquired about is without doubt the upper surface of the valve seat E E, or of the bushing, as it is sometimes termed.

Cross-int. 87. Now, taking the upper surface of the Richardson valve seat E E, as described by him, and the lower surface of Richardson's addition to the common safety-valve, is there or is there not between those two surfaces at all times, whether the valve be opened or closed, an area of opening larger than the area of opening at the ground joint?

Ans. If I understand the question, there is.

Cross-int. 88. What is Richardson's name, in the patent of 1866, for that portion of the structure which constitutes the inner wall of the aperture known in these cases as the stricture?

Ans. The outer edge of the valve seat E E.

Direct examination resumed:

Int. 89. Will you please give the boundaries of the valve seat as shown in cross-section in Fig. 3, thereby indicating its width?

Ans. I don't think I understand the question.

Int. 90. Having given the outer edge of the valve seat to be the outer boundary of this valve seat around which the lip is, please state where the inner edge of the valve seat is, to show the inner boundary line which shall be parallel to the line forming the edge around which the lip laps, as seen in Fig. 3.

Ans. The inner edge of the valve seat E E coincides with the inner side of the annular chamber D D and with the top of the ground joint.

Int. 91. Where the patent says "D D is a circular or annular chamber into which the steam immediately passes when the valve lifts from its seat at the ground joint F F; E E is the valve seat; F F is the ground joint of the valve and seat," is not that portion called the ground joint a portion of the valve seat?

Ans. It is a portion of the valve seat E E.

456 Int. 92. Now, looking at Fig. 3, please state what constitutes the inner side of the valve seat, and what the outer side of the valve seat.

Ans. The inner side of the valve seat E E represents the steamway; the outer side is the extreme diameter of the part E E.

Int. 93. In cross-int. 87 you are asked to compare the area of a cross-section of the annular chamber with the area of an opening at the ground joint when the valve is closed. Is there any opening then at the ground joint?

Ans. No; there is not.

OCTOBER 13, 1887.

Mr. George G. Frost, a witness called in behalf of the complainants, having testified that there were certain statements made up monthly for the directors during the time of his treasurership, extending from the origin of the company to May, 1878, exhibiting, among other items of the business transactions of the defendant company, the cost of safety-valves, and Mr. George H. Eager, a witness called in behalf of the defendants, being the treasurer of the

defendant company, having produced all the statements of any kind which he had received from Mr. Frost, his immediate predecessor, copies of which (being for the fiscal years 1877–'78 and 1878–'79) are made exhibits, it is agreed that similar tabulated statements have been made during the period of the accounting, the later statements being in less detail, and that said depositions need not be printed, and that no further reference be made to them.

Attest: JOHN G. STETSON, *Master.*

Defendants' Reply to Complainants' Request for Production of Records of Defendants' Board of Directors. (*See page* 244.) (*Filed with Master June* 15, 1886.)

Complainants' counsel made the following request of the defendants Jan 14, 1886, and the master ordered the defendants to comply with the same:

457 Mr. Clarke said: Mr. Millett, I notify you, as president of the Crosby Steam Gage and Valve Company, and Mr. Eager, as treasurer of the Crosby Steam Gage and Valve Company, to produce the records of the board of directors of Crosby Steam Gage and Valve Company from Feb. 15, 1879, to Jan. 31, 1885, which contain the declaration of dividends during that period, and also Mr. Eager, as treasurer, to produce the books of the company show- the payments of dividends.

(Production of the books was waived upon submitting a statement by them.)

In reply to the above request, the defendants say that the records of the Crosby Steam Gage and Valve Company show that on May 10, 1879, there was declared a dividend of five dollars per share, payable on June 14, and under said declaration there was actually paid fifteen hundred dollars ($1,500); and that on Nov. 12, of same year, there was declared a dividend of five dollars per share, payable Dec. 15, and under this declaration there was actually paid fifteen hundred dollars ($1,500); and that on May 11, 1880, there was declared a dividend of five dollars per share, payable June 15, and under said declaration there was actually paid fifteen hundred dollars ($1,500); and that on Nov. 10, of the same year, there was declared a dividend of five dollars per share, payable Dec. 15, and under said declaration there was actually paid fifteen hundred dollars ($1,500); and that on Aug. 31, 1881, there was declared a dividend of fifty dollars per share, payable Sept. 1, and under said declaration there was actually paid fourteen thousand three hundred and fifty dollars ($14,350); and on May 27, 1882, there was declared a dividend of nine dollars per share, payable on June 1, and under said declaration there was actually paid eight thousand six hundred and four dollars ($8,604); and on Aug. 24, 1882, there was declared a dividend of six dollars per share, payable Sept. 1, and under said declaration there was actually paid five thousand seven hundred and thirty-six dollars ($5,736); and on Dec. 2, 1882, there was de-

clared a dividend of seven dollars per share, payable Dec. 1, and under said declaration there was actually paid six thousand
458 six hundred and ninety-two dollars ($6,692); and on Feb. 27, 1883, there was declared a dividend of six dollars per share, payable March 1, and under said declaration there was actually paid five thousand seven hundred and thirty-six dollars ($5,736); and on May 15, 1883, there was declared a dividend of nine dollars per share, payable on June 1, and under said declaration there was actually paid eight thousand six hundred and four dollars ($8,604); and on Aug. 31, 1883, there was declared a dividend of ten dollars per share, payable same date, and under said declaration there was actually paid nine thousand five hundred and sixty dollars ($9,560); and on Nov. 28, 1883, there was declared a dividend of seven dollars per share, payable Nov. 30, and under said declaration there was actually paid six thousand six hundred and ninety-two dollars ($6,692); and on Feb. 29, 1884, there was declared a dividend of seven dollars per share, payable March 1, and under said declaration there was actually paid six thousand six hundred and ninety-two dollars ($6,692); and on May 20, 1884, there was declared a dividend of nine dollars per share, payable June 1, and under said declaration there was actually paid eight thousand nine hundred and four dollars ($8,904); and on Sept. 2, 1884, there was declared a dividend of ten dollars per share, payable at same date, and under said declaration there was actually paid nine thousand eight hundred and ninety dollars ($9,890); and on Dec. 1, 1884, there was declared a dividend of seven dollars per share, payable at same date, and under said declaration there was actually paid six thousand nine hundred and twenty-three dollars ($6,923).

At the annual meeting of the corporation May 15, 1882, it was voted by the stockholders to increase the capital stock of the company from thirty thousand dollars ($30,000) to one hundred thousand dollars ($100,000), based upon the surplus as the same appeared on the 30th April, 1882, and on the same day, and in furtherance of the above plan, there was declared a dividend of two hundred thirty-three and one-third dollars ($233⅓) per share on the original capital. This was a dividend in name only, as all the money paid out was paid back immediately for shares of stock purchased.

459 *Exception.*

In obedience to the order and ruling of the master the defendants, under their objection thereto, have submitted the above reply to the complainants' request and now state their exception and protest to said ruling:

First. In this accounting to determine the profits which the defendants have made in that portion of their business as manufacturers of steam-boiler and engine appliances, relating solely to safety-valves and constituting about one-third of their whole business, it is wholly immaterial what dividends they have declared and paid, and therefore inadmissible—

(*a*) Because such dividends may or may not be derived from the

profits of their business, and there is nothing in the bald statement thereof as to any fact of profits;

(*b*) Were it an apparent fact that such dividends are the representative of profits, it does not nor can it appear what of these profits are due to the safety-valve business, inasmuch as in such case they are the representative of the profits of the defendants' entire business;

(*c*) Because, being foreign to the purpose and object of this reference for an accounting, it is inquisitorial in character and can tend only to the annoyance and disturbance of the defendants and their business, and is contrary to the practice and proceedings in equity and against the rights of the defendants.

Second. The defendants, in compliance with the request of the master, have submitted to him a careful and truthful account of their safety-valve business in detail, disclosing in the fullest manner the profits thereof.

This account of the defendants has not been controverted, either directly or indirectly, by any testimony adduced by the complainants. On the contrary, it has been wholly ignored by them and a charge has been filed by them without reference to it. If the issue is founded upon this charge the defendants have not yet been permitted to meet the same, nor can do so until said charge has been established by the complainants or evidence introduced by them which tends to so establish it, which has not yet been done.

460 This order, then, to produce the books of the defendants showing the amount and payment of dividends declared by them, if ever material, which defendants deny, is wholly untimely, and can only tend to prejudice the defendants' rights without having any probative force touching the issue thus presented, even when it is confined to profits only. *Non constat*, the defendants might admit the assumptions of the complainants in their so-called charge when the opportunity is presented. At least this charge deals only with the defendants' safety-valve business, while the inquiry goes out beyond that and insinuates itself into all the transactions of the defendant corporation, and compels the master's attention to those things only of interest to the defendants, which are not of this proceeding before him, to be used to the defendants' disadvantage.

461 *List of Paper Exhibits.*

The following paper exhibits referred to in the report of the "Proceedings before the master" were returned by the master with his report:

	Page.
(1.) General expense account	182
(2.) Accounts of valves returned, Nos. 1, 2, 3, and 4	183
(3.) Exhibit Total Sales	195
(4.) Exhibit Valve Stock in Hand	195
(5.) Moore list (Int. 3)	222
" " (Int. 4)	222

(6.) Crosby Catalogue A (Moore, 37) 234
(7.) " " B (" ") 234
(8.) " " C (" ") 234
(9.) " " D (" ") 234
(10.) Moore cuts A, B, C, and D 237
(11.) Notices A, B, and C 237
(12.) Complainants' Catalogue of 1879 243
(13.) Certified copies of certificates of condition of defendant corporation for years 1876 to 1884, inclusive 243
(14.) Corrected general expense account 250
(15.) Corrected pay-roll 250
(16.) Memorandum of corrections in Schedules 16*a*, 16*b*, 16*c*, and 16*d* 251
(17.) Corrected summaries 251
(18.) Corrected materials purchased 251
(19.) Foster computations, Nos. 1, 2, and 3 287
(20.) Richardson 1866 patent 315
(21.) " 1866 drawing 315
(22.) Defendants' Exhibit Waterman 1853 Patent and Drawing 325
(23.) Harrison Drawing, Defendants' Exhibit Webster Valve, etc. 386
(24.) Government safety-valve tests 386
(25.) Transcript of record in Kunkle case 386

462 *Memorandum as to Paper Exhibits.*

(MEMORANDUM.—Counsel for the respective parties agree that the exhibits above referred to, and scheduled 1 to 25, shall not be included in the transcript of the record in this case, No. 1184, as made up by the clerk of the circuit court for transmission to the Supreme Court of the United States, except the following, as to which statements are made as follows:

(20.) *Richardson* 1866 *Patent.*

This is the patent upon which the bill in this case, No. 1184, was brought, and is set out at length in the transcript of record in the original case, the appeal therein being numbered 127 upon the docket of the Supreme Court at the October term, A. D. 1884. A Patent Office copy of said patent is to be included in the transcript of record herein with the same effect as if duly certified.

(21.) *Richardson* 1866 *Drawing.*

The certificate attached to this drawing is to be included in the transcript of record herein, and the drawing is to be transmitted to the Supreme Court, so as to be before the Supreme Court at the hearing of the appeal herein.

(22.) *Defendants' Exhibit* 1853 *Patent and Drawing.*

The specification of this patent is to be made a part of the transcript of record herein, and the exhibit is to be transmitted to the Supreme Court, that the drawing thereto annexed may be before the Supreme Court at the hearing of the appeal herein.

463 & 464 (23.) *Harrison Drawing, Defendants' Exhibit Webster Valve, etc.*

This drawing is to be transmitted to the Supreme Court, so as to be before the Supreme Court at the hearing of the appeal herein.

(25.) *Transcript of Record in Kunkle Case.*

This transcript was filed in the Supreme Court August 16, 1883, and was numbered 547 at the October term, 1884, and at terms subsequently thereto was numbered 255 and 19, and, being og record in said Supreme Court, counsel agree that it may be referred to as a record of said Supreme Court. If either party deems it necessary that this record should be reprinted for the hearing of the appeal herein, such printing may be done from said Supreme Court record.

JOHN G. STETSON, *Clerk.*)

All the model exhibits referred to in the report of the "Proceedings before the master" were returned by him with his report.

(MEMORANDUM.—The model exhibits above referred to are scheduled in the table of contents accompanying this transcript.

JOHN G. STETSON, *Clerk.*)

466 UNITED STATES PATENT OFFICE.

GEORGE W. RICHARDSON, of Troy, New York.

Improvement in Steam Safety-Valves.

Specification forming part of Letters Patent No. 58294, dated September 25, 1866.

To all whom it may concern:

Be it known that I, George W. Richardson, of the city of Troy, in the county of Rensselaer, in the State of New York, have invented a new and useful improvement on a safety-valve for steam-generators; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making a part of this specification, in which—

(Here follows diagram marked p. 465.)

G. W. Richardson,

Steam Safety Valve.

No. 58,294. Patented Sep. 25, 1866.

No. 1578. C.S.G.V. Co. v. C.S.V. Co. } p. 465

Fig. 1

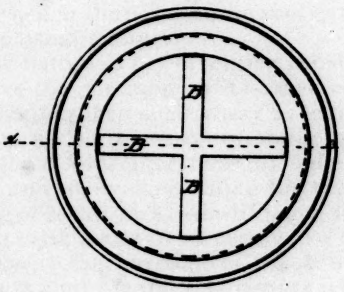


Fig. 2

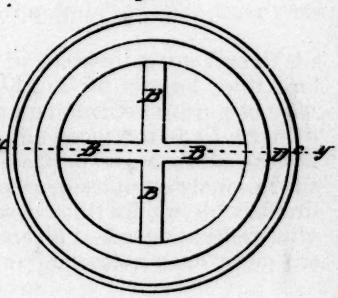


Fig. 3

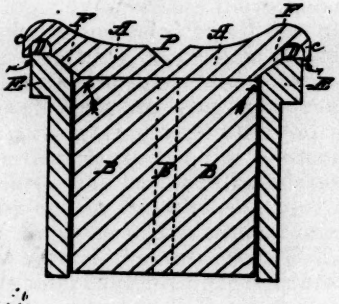
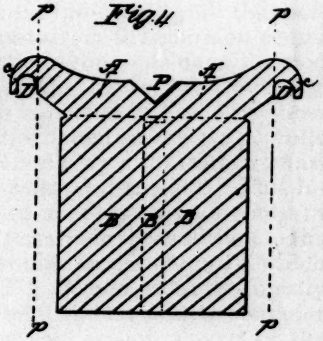


Fig. 4



Witnesses
Geo. Gerhardt
Wm. H. Pope

Inventor.
Geo. Wm. Richardson

Figure 1 is an end view of my improved safety-valve and its seat as seen from the bottom. Fig. 2 is an end view of the valve alone as seen from the bottom. Fig. 3 is a vertical section at *x x*, Fig. 1, of the valve and seat in position. Fig. 4 is a vertical section at *y y*, Fig. 2, of the valve alone.

Similar colors and letters of reference indicate corresponding parts in the several figures.

A A is the head of the safety-valve. B B B B are wings to guide the valve into its seat E E. *c c* is a circular or annular flange or lip extending over, slightly below, and fitting loosely around the outer edge of the valve-seat E E. D D is a circular or annular chamber, into which the steam immediately passes when the valve lifts from its seat at the ground joint F F. E E is the valve-seat. F F is the ground joint of the valve and seat. P is the counter-sink or center, upon which the point of the stud extending from the scale-lever rests in the usual manner.

The nature of my invention consists in increasing the area of the head of the common safety-valve outside of its ground joint, and terminating it in such a way as to form an increased resting-surface, against which the steam escaping from the generator shall act with additional force after it has lifted the valve from its seat at the ground joint, and so, by overcoming the rapidly-increasing resistance of the spring or scales, insure the lifting of the valve still higher, thus affording so certain and free a passage for the steam to escape as effectually to prevent the bursting of the boiler or generator, even when the steam is shut off and the damper left open.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

To the head of the common safety-valve indicated by all that portion of Fig. 2 lying within the second circle from the common center I add what is indicated by all that portion lying outside of the said circle in about the proportion shown in the figure. A transverse vertical section of this added portion is indicated in Fig. 4 by those portions of the figure lying outside of the dotted lines *p p p p*, while all that portion lying within the dotted lines *p p p p* indicates a transverse vertical section of the common safety-valve alone. This increased area may be made by adding to a safety-valve already in use or by casting the whole entire. I terminate this addition to the head of the valve with a circular or annular flange or lip, *c c*, which projects beyond the valve-seat E E, Fig. 3, and extends slightly below its outer edge, fitting loosely around it and forming the circular or annular chamber D D, whose transverse section shown in the figure may be of any desirable form or size. This flange or lip *c c*, fitting loosely around the valve-seat E E, is separated from it by about one sixty-fourth of an inch for an ordinary spring or balance. For a strong spring or balance this space should be diminished, and for a weak spring or balance it should be increased to regulate the escape of the steam as required. Instead of having the flange or lip *c c* project beyond and extend below and around the outer edge of the valve-seat, as shown in Fig. 3, a similar result may be obtained by having the valve-seat itself project beyond the outer edge of the

valve-head, and terminating it with a circular or annular flange or lip extending slightly above and fitting loosely around the outer edge of the flange or lip *c c* of the valve-head; but I consider the construction shown in Fig. 3 preferable.

With my improved safety-valve constructed as now described, and attached to the generator in the usual way, the steam escaping in the direction indicated by the arrows in Fig. 3 first lifts the valve from its seat at the ground joint F F, and then passing into the annular chamber D D acts against the increased surface of the valve-head, and by this means, together with its reaction produced by being thrown downward upon the valve-seat E E, it over-
467 comes the rapidly-increasing resistance of the spring or balance, lifts the valve still higher, and escapes freely into the open air until the pressure in the generator is reduced to the degree desired, when the valve will be immediately closed by the tension of the spring or balance. The escape of the steam by means of this safety-valve is so certain and free that the pressure of the steam in the generator or boiler will not increase beyond the point or degree at which the valve is set to blow off

What I claim as my improvement, and desire to secure by letters patent, is—

A safety-valve with the circular or annular flange or lip *c c*, constructed in the manner, or substantially in the manner, shown, so as to operate as and for the purpose herein described.

GEORGE WM. RICHARDSON.

Witnesses:
GEO. GOULD.
WM. H. POOR.

468 (21.) *Richardson* 1866 *Drawing.*

(2–175.)

DEPARTMENT OF THE INTERIOR.

(Cut.)

UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the records of this office of the original drawing filed in the matter of the letters patent granted G. W. Richardson September 25th, 1866, number 58294, for improvement in safe'y-valve.

In testimony whereof I, M. V. Montgomery, Commissioner of Patents, have caused the seal of the Patent Office to be
[L. S.] affixed this 12th day of December, in the year of our Lord one thousand eight hundred and eighty-five, and of the Independence of the United States the one hundred and tenth.

M. V. MONTGOMERY,
Commissioner.

(MEMORANDUM.—The drawing to which this certificate is attached is to be transmitted to the Supreme Court, so as to be before the Supreme Court at the hearing of the appeal herein.

JOHN G. STETSON, *Clerk.*)

469 (22.) DEFENDANTS' EXHIBIT WATERMAN 1853 PATENT AND DRAWING.

HENRY WATERMAN.

Improvement in Safety-Valves for Locomotive Engines.

Specification forming part of Letters Patent No. 10243, dated Nov'r 15, 1853.

As originally filed.

To all whom it may concern:

Be it known that I, Henry Waterman, of the city of Hudson, county of Columbia, State of New York, have invented a new and improved mode of constructing the safety-valves of locomotive engines; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings and letters of reference marked thereon.

Owing to the jolting of the locomotive engine when in motion, it was found necessary at an early day to discard the use of the simple weight upon the lever of the safety-valves, as large portions of steam would be blown off when the pressure was below the point indicated by the mean pressure of the weight upon the valve, as, for instance, when the boiler was suddenly thrown upward the weight would continue to go up, so that by the recoil and momentum the valve would be a portion of the time raised from its seat and the steam allowed to blow off when below the desired point of pressure. The spring balance was substituted, and has been generally used or applied to the lever of safety-valves.

470 It has been long known that the spring balance is an imperfect indication of the pressure of steam from the following causes:

The safety-valve in raising will raise the outer end of lever that rests upon, though a much greater distance than the valve itself, as the proportions of power of the lever, as, for instance, a lever of a power twelve times, resting on a valve, say two inches diameter, when the valve is raised to its full capacity, say one-half inch, will raise its outer end six inches, a distance quite impossible with an ordinary spring balance without greatly increasing the pressure balance, consequently at the same time increasing the pressure of the steam; so that it will be seen an adequate discharge cannot take place with a spring balance resting upon —. Taking another instance, suppose a valve to raise one-eighth of inch, which allows an escape of about one-fourth the capacity of the valve, the outer end of lever will raise one and a half inch-. If to this a spring balance is at-

tached, with a scale of one-twentieth of an inch to the lb., it is evident that the pressure will be increased thereby thirty lbs. per inch. To remedy this difficulty I propose to use the simple weight and lever, so as to attain as near as possible a constant and uniform pressure upon the valve, and in order to prevent the vibrations of the weight and lever I apply to outer end of lever a rod that descends vertical-, by which the weight is suspended to lever; at the bottom of said rod, below the weight, attach a small piston of about three inches diameter. Surrounding this piston I place a cylinder in which this piston is allowed to move freely and easily. The cylinder is firmly attached to boiler or other convenient parts. Into this cylinder I put a fluid—mercury, oil, alcohol, or water. I prefer good sperm oil. This fluid must fill the cylinder to near the
471 top, so as to completely cover the piston. It is evident that the piston can move no faster than the fluid is made to pass by the piston, and that it will check all sudden vibrations yet freely pass to a position due to pressure, &c. By having an adequate facility of discharging surplus steam we have succeeded in securing an uniform temperature and pressure in the locomotive boiler, preventing almost entirely the difficulty of leakage of tubes, riveted joints, so commonly caused by these vibrations; also design it as a sure preventive of explosion from these causes.

Description of Drawing.

A represents the rear part of boiler.
B " the ordinary safety-valve.
C " the ordinary lever.
D " the weight.
E " the rod upon which the weight is suspended to lever.
F represents the piston, attached to rod E.
G " the cylinder, in which the piston F is allowed to move freely.
H is stand by means of which the cylinder is attached to boiler A.
I I I I represents the fluid in cylinder G, which covers the piston F.

What I claim as my improvement and desire to secure by letters patent is the application of the cylinder, piston, and fluid, combined for the purpose of preventing the vibrations of weight resting upon the safety-valves of the locomotive engine, substantially as heretofore set forth, or by any other mode essentially the same.

HENRY WATERMAN.

Witnesses:
DARIUS PECK.
JAMES CLARK.

Ex'd: G. W.; A. C. W.

472 (MEMORANDUM.—The drawing attached to the above exhibit, making a part thereof, is to be transmitted to the Supreme Court, so as to be before the Supreme Court at the hearing of the appeal herein.

JOHN G. STETSON, *Clerk.*)

473 On the twenty-ninth day of August, A. D. 1889, the following exceptions to the master's report were filed by the defendants:

CONSOLIDATED SAFETY VALVE COMPANY
v.
CROSBY STEAM GAGE AND VALVE COMPANY. } Nos. 1184 and 1199.

Defendants' Exceptions to Master's Report. (*Filed Aug.* 29, 1889.)

Defendants' exceptions to the master's report in the accounting proceedings therein.

And now come the defendants and respectfully except to the master's report upon the following grounds, to wit:

First. Because he disallowed item 7 of statement IV of their account filed in each case, and thereby increased the profits they showed in their valve business in the sum of $1,978.34, whereas he ought to have diminished those profits by said sum, in view of the facts that it was an expense suffered by them in the modification and reconstruction of their safety-valves, having the peculiar characteristics of the Crosby invention, to render them more perfect as instruments of safety and more salable as products; and, because such expense became a wastage in their valve business, it should have been allowed as a proper charge on it.

Second. Because the master found that all the so-called "Richardson valves" sold by the complainants contained the invention of Richardson set forth in the said Richardson patent of 1866, whereas he ought to have found that none of the valves sold by the complainants during the whole period covered by the accounting of
474 the defendants did in fact contain the improvement set forth in the said Richardson patent of 1866, and consequently that the so-called "Richardson valves" sold in the market did not furnish any standard of value for ascertaining the amount of profits or damages to be accounted for by the defendants for their manufacture and sale of steam safety-valves.

Third. Because the master, in stating the account of profits derived by the defendants for the period between Feb. 15, 1879, and Sept. 25, 1883, attributed the entire commercial value of the valves manufactured and sold by the defendants to the improvement covered by Richardson's patent of 1866, and found for and awarded to the complainants the entire profit derived from the sale of steam-valves by the defendants during that period, whereas the master ought to have found that the complainants were entitled to only such profit as they made to appear was due to the use of the improvement set forth in the said Richardson patent of 1866 over and above what would have been derived from the manufacture and sale of safety-valves known to the art prior to the Richardson invention and free to be used by the defendants.

Fourth. Because the master, in view of the fact that the complainants had neglected and refused to submit any evidence as to the comparative value of the Richardson improvements set forth in the Richardson patents of 1866 and 1869 with the value of steam safety-valves known prior to said Richardson's invention and free to be used by the defendants, found that the complainants were entitled to the entire commercial value of the valves manufactured and sold by the defendants, whereas he ought to have found that the complainants were entitled to have a recovery only for the ascertained value of the said improvements over and above the value of previous safety-valves known to the art and open to be used by the defendants.

Fifth. Because the master, notwithstanding that it was made to appear that no steam-valves had ever been constructed and sold by the complainants which contained the Richardson improvement of 1866, refused to require the complainants to show in fact what was the value attributable to said Richardson improvement of 1866, but did find that because the defendants had made use of said Richardson's invention of 1866 they were liable to account for and to
475 pay to the complainants the whole profit derived from the manufacture and sale of steam safety-valves between Feb. 15, 1879, and Sept. 25, 1883.

Sixth. Because the master erroneously assumed that the Supreme Court had in fact found that the steam-valves manufactured and sold by the complainants contained the invention set forth in the Richardson patent of 1866, as such invention by the court was defined to be; and, although he rightly assumed that the Supreme Court had decided that the defendants' valves did contain the invention covered by the Richardson patent of 1866, he nevertheless attributed the entire commercial value of the valves manufactured and sold by the defendants to the improvement covered by such patent, without requiring the complainants to show by proof what was the value of such improvement when introduced into a steam safety-valve in comparison with the value of steam safety-valves previously known to the art and free to the defendants to be used, whereas the master ought to have found, on the record of the case before him, that the defendants were liable to pay to the complainants nominal damages only.

Seventh. Because the master failed to regard the legal construction which had been given to the Richardson patent of 1866 by the Supreme Court, as an improvement in safety-valves, as consisting of a valve in which is combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air to retard the escape of steam, the orifice being proportioned to the strength of the spring, and, notwithstanding that the complainants failed to submit any evidence to show what in fact was the value of such improvement when introduced into a safety-valve, refused to find that the defendants were liable to account for a nominal sum only to the complainants, but did in fact find that the defendants were bound to account to the complainants for the entire commercial value of the

valves manufactured and sold by them during the period covered between Feb. 15, 1879, and Sept. 25, 1883.

Eighth. Because the master, notwithstanding the defendants proved that steam-valves of the Webster type, and free to be used by the defendants, and containing an initial area, an additional
476 area, and an annular chamber beneath the additional area, having a non-strictured orifice leading from such chamber to the open air, were capable of operating, when properly proportioned, and without changing the annular chamber into a huddling chamber with a strictured orifice, with an economy equal that of valves containing the Richardson invention of 1866, and notwithstanding that the complainants did not offer any evidence as to the value of the Richardson improvement of 1866, which consists in substituting in the Webster valve, for the annular chamber and non-strictured orifice leading to the outer air, a huddling chamber and strictured orifice, and did not offer any evidence as to the advantages or savings which would accrue from such Richardson improvement of 1866, found that the entire commercial value of the valves manufactured and sold by the defendants for the period between Feb. 15, 1879, and Sept. 25, 1883, were attributable to the presence in the defendants' valves of the improvement covered by the Richardson patent of 1866, whereas he ought to have found, on the evidence before him, that the defendants were bound to account for and pay a nominal sum only for profits.

Ninth. Because the master, notwithstanding that proof was submitted to him of the value of the improvements covered by divers letters patent in force during the whole period covered by the accounting, to wit, letters patent granted to Crosby, dated Jan. 26, 1875, No. 159,157, and dated Feb. 23, 1875, No. 160,167, refused to ascertain what portion of the profits derived by the defendants from the manufacture and sale of steam-valves was due to such patented improvements belonging to the defendants, but in fact found that the whole commercial value of the defendants' valves was attributable to the improvement covered by the Richardson patent of 1866, and that the defendants were bound to account to the complainants for all the profits which they had received from the manufacture and sale of steam safety-valves containing said inventions belonging to the defendants and incorporated into such valves.

Tenth. Because the master, in ascertaining the profits which had accrued to the defendants from the manufacture and sale of valves for the period between Feb. 15, 1879, and Sept. 25, 1883, did not ascertain what portion of such profits were attributable to the
477 employment in the defendants' valves of the improvement covered by the Richardson patent of 1869, and, notwithstanding that no evidence was submitted on the part of the complainants to enable the amount of profits which had accrued to the defendants from the manufacture and sale of safety-valves during said period to be apportioned between the invention covered by the Richardson patent of 1866 and the invention covered by the Richardson patent of 1869, found that the whole profits which had accrued to the de-

fendants were attributable to the employment in said valves of the invention covered by the Richardson patent of 1866.

B. F. THURSTON,
J. H. MILLETT,
Counsel for Defendants.

478 On the fifth day of September, A. D. 1889, the following exceptions to the master's report were filed by the complainants:

CONSOLIDATED SAFETY VALVE COMPANY
v.
CROSBY STEAM GAGE & VALVE COMPANY. } No. 1184.

Complainants' Exceptions to Master's Report.

On coming in of the master's report in this cause it appears from amended finding 13, page 53, that the master finds as profits on the Richardson patent No. 158,294, from February 15, 1879, to September 25, 1883, as shown by master's corrected Schedule D, the amount of $40,344.59.

It also appears from master's corrected Schedule D, on page 52, that this profit is a balance found by the master by deducting from the total valve sales during the period sundry items of costs and charges, among which figure the item of "general expenses," master's note 26, page 41, to the amount of $51,335.08; "allowances," finding 4, page 8, $565.78; "cost of patterns," finding 5, page 8, $2,924.23.

It also appears that the general expenses included an item for depreciation of assets, which item for this period originally included the depreciation of the patterns belonging to the company (Eager, p. 308, Ints. 76, 80), which item in the amended expense account was taken out, and the item for depreciation of assets was rectified, and the amended general expense account filed (Eager, p. 373, Int. 2). The difference between the two sums for depreciation of assets was $276.53, of which $159.77 belonged to the period of 1879–'80, $111.76 belonged to the period of 1881–'82, and $5 belonged to the period from May 1, 1883, to September 25, 1883.

479 It also appears from master's corrected Schedule E, page 52, that the cost of valve patterns increased from September, 1883, to January 31, 1884, $413.01, and from the two expense accounts that there was no depreciation of value in the valve patterns during that period. The value of the valve patterns made before the 31st of January, 1884, was on that date equal to their cost, less $276.53, or $3,060.71, and the cost of the patterns made after September 25, 1883, was $413. The cost of the valve patterns during that period was $2,924.23, as charged in the master's account; the depreciation was $276.53, and their value on the 31st of January, 1884, was $2,647.70. These patterns were refused by the court to the complainant. They were not produced before the master.

It also appears from finding 4, page 8, that allowances to the amount of $565.78 were made, as set forth in Schedule C, and tha

these allowances are allowances claimed in the schedule of "valves returned," &c., numbered as set forth in the margin of Schedule C. Certain of these allowances claimed in these schedules of "valves returned," &c., are credited in the Schedule A of sales, and in the Schedule B of costs. A comparison of the three Schedules A, B, and C shows that the amount of item 70 appears in the list of sales and in the list of costs, and the credit in Schedule C is for the amount in the list of sales, and that the defendants are credited with the cost of a valve and with the selling price of the valve, and are charged only with the selling price.

It appears also that item 71, "valve lost August 28th," appears in Schedule A as a deduction from the charges of sales and does not appear in Schedule B as a deduction from the credit for cost of valves sold, whereby the cost of said valve, $28, is credited to the defendants twice, one of which credits is certainly wrong, and both of them complainants contend to be wrong.

It also appears that item 172 is not deducted from either Schedule A 5, page 17, nor Schedule B 5, page 21; and that item 173 is not deducted from either Schedule A 4, page 17, nor B 4, page 20; and that item 174 is not deducted from Schedule A 5, page 17, nor B 5, page 21; and that item 175 is not deducted from Schedule A 4, page 17, nor Schedule B 4, page 20; and that item 177 is not de-
480 ducted from Schedule A 2, page 16, nor Schedule B 2, page 19; and that items 180 and 194 are not deducted from Schedule A 3, page 16, nor Schedule B 3, page 20; and that item 245 is not deducted from Schedule A 5, page 17, nor from Schedule B 5, page 21, whereby each and every of said items, 172, 173, 174, 175, 177, 180, 194, and 245, classified as uncollectible items, present a charge against the defendants in the Schedule A of sales for the selling value of the goods, a credit in Schedule B for the cost value of the goods, a credit in the expense account for a percentage on the selling value of the goods, and a credit in Schedule C for the whole value of the goods.

It also appears that items 178 and 179, for valves lost, are not charged to the defendant in the sales account, Schedule A 2, page 16, but are credited to the defendants in the cost account, Schedule B 2, page 19, whereby on the three items, 71, 178, and 179, the defendants are not charged with any receipts and are credited with the cost of the valves twice.

Upon these facts the complainants except as follows:

To the allowance for uncollectible items credited to defendants in Schedule C, viz:

Item	70	$67 50
	172	7 50
	173	45 00
	174	52 00
	175	200 75
	177	25 00
	180	7 50
	194	4 50
	245	50 00

And to twice the amount of—

Item	71	$28 00	$56 00
	178	9 62	19 24
	179	26 30	52 60
			$587 59

481 But inasmuch as this amount exceeds the whole amount of the schedule, and the items for special expenses and special services, 73 and 315, were conceded to be admissible charges, the complainants merely pray the court to reduce the Schedule C of allowances from $565.78 to $42.11, by disallowing $523.67 of the allowances claimed.

In case the court shall not be of opinion that the uncollectible items should be cancelled in full, certainly they should be chanceried to their costs, and in any event the cost of the valves lost, which bring no return to the complainants according to the schedule of sales should not be charged against them more than once, viz., in the schedule of costs, and not a second time in the schedule of allowances, and $63.92 of this schedule of allowances should be, at any rate, cancelled.

Exception 2. Complainants except to the allowance of the item "cost of patterns," except to the extent of their depreciation. Total cost of patterns, $2,924.23; depreciation before January 31, 1885, $276.53; amount to be disallowed of the item of "cost of patterns," $2,647.70.

These two exceptions being sustained, complainants move for the modification and amendment of the master's report as follows:

Profits as by amended finding 13, page 53	$40,344 59
Add for value of patterns January 31, 1885	2,647 70
Add for disallowance of duplicate charges for valves lost	63 92
Add for disallowance of uncollectible items	459 75
	$43,515 96

And complainants move the confirmation of the master's report as thus amended.

By their attorney, THOS. WM. CLARKE.

482 This case was thence continued to the October term of this court, A. D. 1889, when the same came on to be heard by the court upon the exceptions of the complainants and of the defendants to the master's report, and was thence continued under advisement to this present May term, A. D. 1890, when, on the seventh day of October, the opinion of the court is announced, and on the eleventh day of October the following final decree is entered:

Final Decree, October 11, 1890.

COLT, *J.:*

This cause came on to be heard at the October term, 1889, was argued by counsel, and was taken under advisement and continued for judgment; and now, at this May term, 1890, to wit, this eleventh day of October, A. D. 1890, on motion of Mr. T. W. Clarke, of counsel with complainants, and after hearing Mr. J. H. Millett, of counsel with defendants, it is ordered, adjudged, and decreed—

1st. The master's report herein is confirmed, and the exceptions thereto, filed by complainants and by defendants respectively, are overruled, and judgment herein is entered for the complainants in the sum of forty thousand three hundred and forty-four dollars and fifty-nine cents ($40,344.59), with interest thereon from the date of the filing of the master's report, to wit, from August 5, 1889.

2nd. That complainants recover their costs of suit in this court prior to the entry of the appeal to the Supreme Court, including the cost of the transcript of the record sent to the Supreme Court and their costs in this court and before the master, subsequent to the filing of the mandate in this court, taxed at $2,394.10.

3rd. That complainants have execution for said damages and costs.

By the court:

JOHN G. STETSON, *Clerk.*

483 Upon the entry of the said final decree the following exception is filed by the defendants and overruled by the court:

Defendants' Exception. (*Filed October* 11, 1890.)

And now come the defendants and respectfully except to the refusal by this honorable court of the defendants' request to allow interest upon the amount of profits and damages ascertained by the court to be charged against the defendants only from the date of the decree, to wit, October 11, 1890.

CROSBY STEAM GAGE & VALVE CO.,
By J. H. MILLETT, *Def'ts' Solicitor.*

Upon the entry of the final decree herein, the defendants in open court claim an appeal to the Supreme Court of the United States and give sufficient security that they will prosecute their appeal to effect and answer all damages and costs if they fail to make their plea good; and thereupon said appeal is allowed by the court.

A true record.

Attest: JOHN G. STETSON, *Clerk.*

484 The following is the opinion of the court in accordance with which the final decree was entered in this case, No. 1184, on the eleventh day of October, A. D. 1890:

Circuit Court of the United States, District of Massachusetts. In Equity.

CONSOLIDATED SAFETY VALVE COMPANY
v.
CROSBY STEAM GAGE AND VALVE COMPANY. } Nos. 1184 and 1199.

Opinion of the Court (*October* 7, 1890).

COLT, *J.*:

These cases now come before the court upon exceptions to the master's report.

In No. 1184 the master finds that the complainants are entitled to recover the sum of $40,344.59 for the profits received by the defendants from the infringement of the Richardson 1866 patent, No. 58294. Master's Report, page 52.

In No. 1199 the master finds that the defendants had made no more than nominal profits from the infringement of the Richardson 1869 patent, No. 85963. Master's Report, page 24.

The main question raised by the defendants' exceptions relates to the method adopted by the master in estimating the profits allowed in case No. 1184.

485 These suits were originally brought in the circuit court, and decrees were entered dismissing the bills. The Supreme Court, upon appeal, reversed the decision of the circuit court and remanded the cases to this court, with directions to enter decrees sustaining the validity of the Richardson patent, decreeing infringement of both patents, and directing an account to be taken of profits as to both patents, and to take such further proceedings as may be proper and not inconsistent with the opinion of the court.

In judging of the correctness of the method pursued by the master in his estimation of defendants' profits the construction put upon the Richardson 1866 patent and the language used in respect thereto, as embodied in the opinion of the court, cannot be disregarded. It was clearly the duty of the master in his findings, as it is also the duty of the court at the present time, to give full force and effect to the opinion of the Supreme Court. If the contention of the defendants is sound, that the Supreme Court in their interpretation of the Richardson 1866 patent gave too much prominence to the feature known as the huddling chamber with a strictured orifice, it is for them, upon appeal, to obtain some modification of that opinion; but so long as it stands as the opinion of that court the views therein expressed should be strictly carried out.

The position, therefore, taken by the defendants, that the complainants are only entitled to nominal damages because, as they say, the Richardson valve of commerce does not contain the huddling chamber with a strictured orifice, or, in other words, a huddling chamber with an aperture for the exit of the steam into the open air, which is of smaller area than the aperture at the ground joint, I cannot regard as sound in view of the opinion of the Supreme Court.

That court construed the Richardson patents, and it held that
486 defendants' valve was within those patents, and it gave a broad construction to the Richardson 1866 patent.

Upon this point I approve and adopt the conclusions reached by the master in the following language, taken from his report, in considering the accounting in No. 1184, for the period from February 15, 1879, to Sept. 25, 1883:

"I attribute the entire commercial value of the valves manufactured and sold by the defendants to the improvement covered by Richardson's patent of 1866. Richardson's invention, as described and claimed in that patent, revolutionized the art of relieving steam boilers from steam pressure rapidly approaching the dangerous point. It made effective for that purpose—rapidly and with comparatively small loss of steam—apparatus described in other patents, which very nearly embodied Richardson's invention, but did not actually contain it. The Supreme Court, in these cases, has defined this invention, and has declared it to be a vital one—a life-giving principle to structures very nearly approaching, but not quite containing, an embodiment of Richardson's discovery.

It was contended before me that none of the complainants' valves of commerce contained this invention of Richardson, but, upon the whole evidence, with specimens of all the different valves put on the market by the complainants before me, I find that they all contain Richardson's improvement of 1866. The Supreme Court has decided in these cases that the defendants' valves contain this invention, and it is under this decision that the accounting in No. 1184 is before me. Eliminate this invention from the defendants' valves and they would
be commercially worthless. No substitute for this invention
487 has been suggested to me, and I know of none which the defendants could have used in its place to have made their valves of commercial value. The defendants claim that some of the profits which they have made are due to the peculiar form of their valves, but the form which they used in making their valves was the form in which they clothed the Richardson invention, the life of their valves, and without that life the Crosby form is worthless.

The defendants claimed before me that the complainants in the accounting in 1184, which relates only to the Richardson patent of 1866, should prove specifically the value of the invention secured to them under that patent as used by the defendants, and that as it was claimed by complainants (and the Supreme Court has so decided) that defendants used also Richardson's invention of 1069, the value of the invention secured to the complainants by the 1869 patent must be determined, and not made an element in the recovery to be had under the accounting in 1184. I have no means of determining the value of that invention as used by the defendants from Feb. 15, 1879, to Sept. 25, 1883, or of stating in dollars and cents how much of the profits of the defendants during that period is due to that invention. The complainants claimed that during that period all the profits of the defendants were due to the Richardson invention of 1866, and, as the Richardson invention of 1869 belonged also to the complainants, and as the complainants and defendants

were respectively the same in each case, 1184 relating to the said invention of 1866, and 1199 relating to the invention of 1869, and as the said period from Feb. 15, 1879, to Sept. 25, 1883, was included within the period to be covered by the accounting in each case, no injustice is done the defendants in acceding to the complainants' claim in this regard, and this is especially so in view of the
488 fact that the defendants claimed that the adjustable device as shown in the Richardson patent of 1869 is worthless as such, and that the cost of the Crosby valve is less without the said so-called adjustable ring, and is a better and more useful safety appliance."

This disposes of the principal question raised by the defendants' exceptions to the master's report. As for the objections to the findings of the master respecting expenses to be allowed for certain valves destroyed, which forms the subject-matter of the first exception, I think the master was right in the conclusion he reached. The defendants were not charged on valves which were subsequently destroyed, or, if so, they were not charged upon the new valves which replaced them. See master's note 29, page 43 of master's report. The master properly disallowed the cost of destroyed valves.

The complainants have filed two exceptions to the master's report in No. 1184, one relating to cost of patterns allowed to the defendants by the master, and the other to the allowance of uncollectible items, etc., in master's Schedule C. I see no sufficient reason to disturb these findings. If there is error in the allowance of any of the items of Schedule C, the suggestion of error was not made to the master in such form as to give the court the benefit of his judgment thereon.

In No. 1199 the complainants have filed several exceptions. They except to the finding of the master that he had no means of determining from the evidence before him what portion of the defendants' profits were attributable to the use of the Richardson patent of 1869, and they further except to the finding of the
489 master that the defendants have made only nominal profits from the infringement of the 1869 patent, and that the complainants have suffered only nominal damages from said infringement.

Down to the expiration of the Richardson 1866 patent, or until September 25, 1883, the complainants contended, in the case brought upon that patent, that all the profits of the defendants were due to that patent, and the master so found.

If the 1869 patent contributed more than a nominal value to the defendants' infringing valves during the life of the 1866 patent, it was the duty of the complainants to have shown that fact in the suit upon the 1866 patent, and to have allowed a corresponding reduction in the finding of profits in that suit. After contending for and accepting such a finding, that the complainants were entitled to all the profits of the defendants from their infringement of the 1866 patent by the manufacture and sale of valves containing the Richardson inventions of 1866 and 1869, they cannot be permitted, upon a bill of complaint against the same defendants, to recover more

than nominal profits or damages for an infringement of the 1869 patent only.

Upon the question of damages the master finds as follows:

"With regard to these claims for damages, I find upon an examination of the evidence before me that if I allow any substantial portion of them I must allow them in full as claimed. I say 'substantial portion' because there are a few dollars that I might, perhaps, allow in No. 1184, upon special evidence relating to a few items; but beyond a few dollars the claims stand or fall as a whole. I know no justifiable method of scaling them.

490 The evidence in support of these claims comes from Charles A. Moore, the manager of the business of complainants, so far as putting valves on the market is concerned, and the evidence against these claims comes from Francis T. Simmons, a salesman of defendants from February, 1878, to May, 1886, and George H. Eager, treasurer of the defendants. The evidence shows that the complainants acquired the Richardson patents Feb. 15, 1879. The defendants were at that time established in the valve business and sold steam safety-valves in competition with whatever valves were in the market. There were persons and firms to whom they sold their productions and whom they considered their customers. The complainants, in 1879, soon after acquiring the Richardson patents, issued a catalogue giving their prices for safety-valves, but quoted their valves in 1879, to some parties at least, at a large discount from their catalogue prices, in one instance a discount of fifty per cent. The basis of these claims is that the complainants had an established lowest price for their several classes of valves in 1879. I do not think the evidence supports this proposition to the extent that I can find that the prices given in Mr. Moore's tables and annexed to complainants' charges in damages are the lowest prices of the complainants in 1879. The complainants went into active competition with all valve producers of every class. Doubtless the defendants were their chief competitors, but I cannot determine from the evidence how much of the reduction in prices which the complainants made from time to time was due to defendants' competition and how much to other causes. Doubtless both parties were trying to hold the market

491 as against each other and as against all other competitors in the business. Under these circumstances, a general claim, even accompanied by a specification of items, cannot be maintained upon testimony relating to comparatively few instances, as in this case, and especially where some of the instances are subsequently explained in a manner to materially affect their force as evidence bearing upon the question of damages resulting from direct competition."

The complainants have filed no exceptions to the finding of the master in No. 1184, that they have suffered no damages in addition to profits.

Upon the whole evidence on this question of damages, I think the master was also right in finding that the complainants are entitled to recover in No. 1199 only nominal damages.

The exceptions in both cases are overruled and the master's report confirmed.

So ordered.

492 *Clerk's Certificate.*

UNITED STATES OF AMERICA, } ss:
Massachusetts District, }

I, John G. Stetson, clerk of the circuit court of the United States for the first circuit and district of Massachusetts, certify that the foregoing is a true copy of the record of said circuit court in the cause, in equity, entitled Consolidated Safety Valve Company, complainants, *v.* Crosby Steam Gage and Valve Company, defendants, No. 1184, lately determined in said circuit court, and of all proceedings therein and of the opinion of the court filed therein.

In testimony whereof I hereunto set my hand and affix the seal of said circuit court, at Boston, in said district, this [SEAL.] eleventh day of October, in the year of our Lord one thousand eight hundred and ninety, and of the Independence of the United States the one hundred and fifteenth.

JOHN G. STETSON, *Clerk.*

493 *Bond to Party on Appeal.*

Know all men by these presents that we, The Crosby Steam Gage and Valve Company, a corporation existing under the laws of the State of Massachusetts, having its usual place of business in Boston, in said State, as principal, and George H. Eager, of Boston, and Joshua H. Millett, of Malden, both in said State of Massachusetts, as sureties, are held and firmly bound unto The Consolidated Safety Valve Company of Hartford, Connecticut, a corporation duly established under the laws of the State of Connecticut, in the full and just sum of fifty thousand dollars, to be paid to the said Consolidated Safety Valve Company, their certain attorney, successors, or assigns; to which payment, well and truly to be made, we bind ourselves, our successors and assigns, and our heirs, executors, and administrators, jointly and severally, by these presents.

Sealed with our seals and dated the eleventh day of October, in the year of our Lord one thousand eight hundred and ninety.

Whereas lately, at a circuit court of the United States within and for the district of Massachusetts, in a suit, in equity, depending in said court between the said Consolidated Safety Valve Company, complainants, and the said Crosby Steam Gage and Valve Company, defendants, a decree was rendered against the said defendants, and the said defendants having obtained an appeal to remove the said cause to the Supreme Court of the United States to reverse the decree in the aforesaid suit, and a citation directed to the said complainants, citing and admonishing them to be and appear at a Supreme Court of the United States to be holden at Washington on the second Monday of October next:

Now the condition of the above obligation is such that if the said defendants shall prosecute their said appeal to effect and answer all damages and costs if they fail to make their plea good, then the above obligation to be null and void; otherwise to remain in full force and virtue.

In witness whereof the said Crosby Steam Gage & Valve Co., by its treasurer, George H. Eager, thereto duly authorized, hereby signs these presents and affixes its official seal.

CROSBY STEAM GAGE & VALVE CO., [L. S.]
By GEO. H. EAGER, *Treasurer.*
GEO. H. EAGER. [L. S.]
JOSHUA H. MILLETT. [L. S.]

Signed, sealed, and delivered in presence of—
JOHN G. STETSON.

Approved.
LE BARON B. COLT,
U. S. Circuit Judge.

A true copy of the bond taken by the judge at the time of allowing the appeal named in said bond; which bond is on file in the office of the clerk of the circuit court of the United States for the first circuit and district of Massachusetts.

Attest: JOHN G. STETSON,
Clerk U. S. C. C., Mass. Dist.

Endorsed on cover: Massachusetts C. C. U. S. No. 1578. The Crosby Steam Gage and Valve Company, appellant, *vs.* The Consolidated Safety Valve Company. Filed December 29, 1890.

FILED.
OCT 10 1891
JAMES H. McKENNEY,
CLERK.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1891.

No. 999.

THE CROSBY STEAM GAGE AND VALVE COMPANY,

APPELLANTS,

v.

THE CONSOLIDATED SAFETY VALVE COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE DISTRICT OF MASSACHUSETTS.

APPELLANTS' BRIEF.

EDMUND WETMORE,
JOSHUA H. MILLETT,
Counsel for Appellants.

Supreme Court of the United States.

OCTOBER TERM, 1891.

No. 999.

THE CROSBY STEAM GAGE AND VALVE COMPANY,

APPELLANTS,

v.

THE CONSOLIDATED SAFETY VALVE COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE DISTRICT OF MASSACHUSETTS.

APPELLANTS' BRIEF.

STATEMENT.

The appellants in this suit were defendants in the suit in the Court below.

This suit is a cause in equity, and was heard by this Court at the October term of 1884, upon an appeal by the complainants, being No. 127 of the docket thereof, conjointly with another suit between the same parties, being No. 128 of the said docket, upon the same record; the appellants herein there being the appellees.

The opinion of this Court therein is reported in the 113 U. S. 157.

Upon the decision by this Court of the said causes, they were remanded to the Court below, and duly referred to a master to take, ascertain and report an account of profits and damages as required by the decrees fully entered therein.

Upon the filing of the master's report, the appellants (defendants) duly filed their exceptions thereto (Rec. pages 344, 345), which were overruled by the Court below, whose opinion is found in the Record, on page 352.

The period of accounting was between Feb. 15, 1879, and Sept. 25, 1883.

The master found the total profits of the defendants in their valve business during this period to have been the sum of $40,344.59, and that the appellees (complainants) were entitled to the same because of the defendants' infringement of the Richardson patent of 1866, by making and selling the Crosby valve. (See amended findings 13 and 15 of the Master, Rec., page 35.)

In the decision of this Court, 113 U. S. 157, it considered the scope of the Richardson patent of 1866, and the peculiar characteristics of the Richardson safety valve described therein. Of this latter, it said as follows: —

"Richardson's patent of 1866 states that the addition to the head of the valve terminates in an annular lip, which fits loosely around the valve seat, and is separated from it by about one sixty-fourth of an inch for an ordinary spring, and a less space for a strong spring, and a greater space for a weak spring, forming an annular chamber, and regulating the escape of the steam; that the steam, when the valve is lifted, passes beyond the valve seat, and into the annular chamber, and acts against the increased surface of the valve head, and thus overcomes the increasing resistance of the spring due to its compression, and lifts the valve higher, and the steam escapes freely into the open air, until the pressure is sufficiently reduced, when the spring immediately closes the valve." (Page 171.) "It appears to have been easy enough to make a safety valve which would relieve the boiler, but the problem was to make one which, while it opened with increasing power in the steam against the increasing resistance of a spring, would close suddenly and not gradually, by the pressure of the same spring against the steam. This was a problem of the reconciliation of antagonisms, which so often recurs in mechanics, and without which practically successful results are not attained. What was needed was a narrow stricture to hold back the escaping steam, and secure its expansive force inside of the lip, and thus aid the direct pressure of the steam from the boiler, in lifting the valve against the increasing tension of the spring, with the result, that, after only a small, but a sufficient, reduction in the boiler pressure, the compressed spring would, by its very compression, obtain the mastery and close the valve quickly. This problem was solved by Richardson and never before. His patent of 1869 describes the arrangement and operation of the whole apparatus, with the adjustable ring, thus: When the pressure of the steam lifts the valve, the steam acts against the surface of an annular space between the bevel of the valve seat and the downward-projecting flange of the cap plate, to assist in holding up the valve against the increasing resistance of the spring. The aperture between the valve and its seat is always

greater than that between the flange and the upward-projecting rim, and thus the steam in the annular space assists in holding up the valve till the boiler pressure falls below that at which the valve opened." (Page 172.) "Richardson is, therefore, entitled to cover, by the claim of his patent of 1866, under the language, 'a safety valve with the circular or annular flange or lip *cc*, constructed in the manner, or substantially in the manner, shown, so as to operate as and for the purpose herein described,' a valve in which are combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air, the orifice being proportioned to the strength of the spring as directed." (Page 176.) "*In the Richardson valve, all the steam which escapes into the open air escapes from the huddling chamber, through a stricture which is smaller than the aperture at the ground joint.*" (Page 178.)

By its discriminating view of the Richardson invention, the appellants believed that this Court found that the radical distinction between it and that which was exhibited in former organizations having the same general elements in combination, was the peculiarity or characteristic which had been given by Richardson to the steam chamber, or, to use the correct expression, the huddling chamber in which the area of the opening for the entrance of steam into it at the ground joint was *larger* than the area of the exit or discharge aperture from it. It appeared that the reverse of this was true, as to the other safety valves of prior date to the Richardson; and that those did not have a huddling chamber because the area of the opening for the entrance of steam into the chamber at the ground joint, formed by the valve extension, was *smaller* than the area of the exit or discharge aperture from it.

The appellants claimed with all due respect to the statement in the opinion of this Court, as to the value of valves of the Richardson type above defined as commercial articles, that they were less than the value of safety valves of the opposite type above described, because they were less economical in their operation and use as safety appliances for steam boilers; and that they had a right to determine this value in an accounting proceeding where they were held to have made a safety valve which infringed the Richardson patent, in finding what profits they were to account for.

They felt justified in this view, inasmuch as it was not opposed to the considerations of this Court, expressed in its opinion as to the utility of the Richardson patent and invention, in determining the question of infringement only; therefore, they introduced testimony before the master, together with exhibits of every type of safety valve made by the appellees, and showed without contradiction that all these valves were constructed without the characteristics of the Richardson valve; in other words, that the apertures of discharge from their steam chambers were greater than the apertures of entrance into them; thus coming within the scope of the decision of this court in the case of these appellees against Kunkle, 119 U. S. 45. They also caused to be made and introduced before the master, with explanatory testimony, safety valves made strictly according to the dimensions given by Richardson in the original drawings filed in the Patent Office, and those shown in the published copy of his patent of 1866. These valves conformed exactly to the interpretation of the Richardson patent of 1866 by this Court, in that they had a huddling chamber in which the aperture of entrance at the ground joint was larger in area than the area of the aperture of discharge from such chamber when the valve was in operation. These valves, when put into use in the ordinary way, caused so great a loss of steam that they were not prudent safety valves, and were commercially worthless.

Notwithstanding this position of the appellants, the master found that he was controlled by the decision of this Court in its finding as to the operation and commercial value of the Richardson valve; and so found that the appellees' valves contained the Richardson improvement of 1866. The Court below approved and adopted the conclusions of the master in his own language. Upon this view of the matter, the Court in its opinion spoke as follows: —

"In judging of the correctness of the method pursued by the master in his estimation of defendants' profits, the construction put upon the Richardson 1866 patent, and the language used in respect thereto, as embodied in the opinion of the Court, cannot be disregarded. It was clearly the duty of the master in his findings, as it is also the duty of the Court at the present time, to give full force and effect to the opinion of the Supreme Court. If the contention

of the defendants is sound, that the Supreme Court in their interpretation of the Richardson 1866 patent gave too much prominence to the feature known as the huddling chamber with a strictured orifice, it is for them, upon appeal, to obtain some modification of that opinion; but so long as it stands as the opinion of that Court the views therein expressed should be strictly carried out.

"The position, therefore, taken by the defendants, that the complainants are only entitled to nominal damages because, as they say, the Richardson valve of commerce does not contain the huddling chamber with a strictured orifice, or, in other words, a huddling chamber with an aperture for the exit of the steam into the open air, which is of smaller area than the aperture at the ground joint, I cannot regard as sound, in view of the opinion of the Supreme Court."

By the action of the master, the appellants were also deprived of all advantages and benefits arising from the Webster valve, and the embodiment of the Crosby patent in the appellants' valve as to value and economy in determining the profits due from the Crosby infringement as found by this Court.

The appellants' contention as to the master's disallowance of certain items in stating their account, and the Court's action as to interest on profits found are stated in the consideration of the errors, *infra*.

SPECIFICATION OF ERRORS.

The appellants submit the following specification of errors as showing wherein the decree of the Court below is erroneous: —

First. Because it disallows Item 7 of Statement IV. of their account filed herein (Rec. pages 27–29; Crosby's testimony, pages 152, 153), and thereby increased the profits they showed in their valve business in the sum of $1,952.94; whereas it ought to have diminished those profits by said sum, in view of the facts that it was an expense suffered by them in the modification and reconstruction of their safety valves, having the peculiar characteristics of the Crosby invention, to render them more perfect as instruments of safety and more salable as products; and because such expense was a wastage in their valve business.

Second. Because it finds that all the so-called "Richardson

valves" sold by the appellees (complainants) contained the invention of Richardson set forth in the said Richardson patent of 1866; whereas it ought to have been found that none of the valves sold by them during the whole period covered by the accounting of the appellants (defendants) did in fact contain the improvement set forth in the said Richardson patent of 1866, and, consequently, that the so-called "Richardson valves" sold in the market did not furnish any standard of value for ascertaining the amount of profits or damages to be accounted for by the appellants in their manufacture and sale of steam safety valves.

Third. Because it sustains the master, who, in stating the account of profits derived by the appellants for the period between Feb. 15, 1879, and Sept. 25, 1883, attributed the entire commercial value of the valves manufactured and sold by them to the improvement covered by Richardson's patent of 1866, and found for and awarded to the appellees the entire profit derived from the sale of steam valves by the appellants during that period; whereas the master ought to have found that the appellees were entitled to only such profit as they could make appear was due solely to the use of the improvement set forth in the said Richardson patent of 1866 over and above what would have been derived from the manufacture and sale of safety valves known to the art prior to the Richardson invention, and free to be used by the appellants.

Fourth. Because it sustains the master, who, in view of the fact that the appellees had neglected and refused to submit any evidence as to the comparative value of the Richardson improvements set forth in the Richardson patents of 1866 and 1869 with the value of steam safety valves known prior to said Richardson's invention, and free to be used by the appellants, found that the appellees were entitled to the entire commercial value of the valves manufactured and sold by the appellants; whereas he ought to have found that the appellees were entitled to have a recovery only for the ascertained value of the said improvements over and above the value of previous safety valves known to the art, and open to be used by the appellants.

Fifth. Because it sustains the master, who, notwithstanding

that it was made to appear that no steam valves had ever been constructed and sold by the appellees which contained the Richardson improvement of 1866, refused to require them to show in fact what was the value attributable to said Richardson improvement of 1866, but did find that because the appellants had made use of said Richardson's invention of 1866, they were liable to account for and to pay to the appellees the whole profit derived from the manufacture and sale of steam safety valves between Feb. 15, 1879, and Sept. 25, 1883.

Sixth. Because it sustains the master, who erroneously assumed that this Court had, in fact, found that the steam valves manufactured and sold by the appellees contained the invention set forth in the Richardson patent of 1866, as such invention was defined to be; and, although he rightly assumed that this Court had decided that the appellants valves did contain the invention covered by the Richardson patent of 1866, he nevertheless attributed the entire commercial value of the valves manufactured and sold by the appellants to the improvement covered by such patent, without requiring the appellees to show by proof what was the value of such improvement when introduced into a steam safety valve in comparison with the value of steam safety valves previously known to the art, and free to the appellants to be used; whereas, the master ought to have found, on the record of the case before him, that the appellants were liable to pay to the appellees nominal damages only.

Seventh. Because it sustains the master, who failed to regard the legal construction which had been given the Richardson patent of 1866 by this Court as an improvement in safety valves, as consisting of a valve in which is combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air to retard the escape of steam, the orifice being proportioned to the strength of the spring; — and who, notwithstanding that the appellees failed to submit any evidence to show what in fact was the value of such improvement when introduced into a safety valve, refused to find that the appellants were liable to account for a nominal sum only, to them, but did in fact find that the appellants were bound to

account to them for the entire commercial value of the valves manufactured and sold by them during the period covered between Feb. 15, 1879, and Sept. 25, 1883.

Eighth. Because it sustains the master, who, notwithstanding the appellants proved that steam valves of the Webster type, and free to be used by them, containing an initial area, an additional area and an annular chamber beneath the additional area, having a non-strictured orifice leading from such chamber to the open air, were capable of operating, when properly proportioned, and without changing the annular chamber into a huddling chamber with a strictured orifice, with an economy equal to that of valves containing the Richardson invention of 1866; and who, notwithstanding that the appellees did not offer any evidence as to the value of the Richardson improvement of 1866, which consists in substituting in the Webster valve for the annular chamber and non-strictured orifice leading to the outer air, a huddling chamber and a strictured orifice, and did not offer any evidence as to the advantages or savings which would accrue from such Richardson improvement of 1866, found that the entire commercial value of the valves manufactured and sold by the appellants for the period between Feb. 15, 1879, and Sept. 25, 1883, were attributable to the presence in the appellants' valves of an improvement covered by the Richardson patent of 1866; whereas he ought to have found, on the evidence before him, that the appellants were bound to account for and pay a nominal sum only for profits.

Ninth. Because it sustains the master, who, notwithstanding that proof was submitted to him of the value of the improvements covered by divers Letters Patent in force during the whole period covered by the accounting, to wit, Letters Patent granted to Crosby, dated Jan. 26, 1875, No. 159,157, and dated Feb. 23, 1875, No. 160,167, refused to ascertain what portion of the profits derived by the appellants from the manufacture and sale of steam valves was due to such patented improvements belonging to them, but in fact found that the whole commercial value of their valves was attributable to the improvement covered by the Richardson patent of 1866, and that they were bound to account to the appellees for all the profits which they had received from the manufacture and sale of

steam safety valves containing said inventions belonging to them and incorporated into such valves.

Tenth. Because it allows interest on the sum of $40,344.59, as stated therein, from Aug. 5, 1889, the date of filing the master's report, instead of from the date of the decree.

CONSIDERATION OF THE ERRORS.

FIRST ERROR.

This error relates to the disallowance of Item 7 of Statement IV., and is briefly this: The appellants claim the sum of $1,952.94, disallowed by the master. They claim this sum on the following ground (see appellants' objections preceding master's Note 29, Master's Report, Rec., pages 27–29): Certain iron and brass valves, which have been fully accounted for by the appellants, were made and sold to divers parties. These valves were returned to them because they were not satisfactory, and were broken up and destroyed. New valves were made to replace the ones so returned, and were delivered to the customers in lieu of those returned. In addition, certain other valves of the same kind were on hand and had never been put into the market, but were destroyed by the defendants because they contained the same defects as those which were returned. No account of these valves on hand and so destroyed was made to the master. The cost of making new valves to supply those above mentioned, which were returned, involved an expense to the appellants, as also did the destruction of the valves on hand which had not been sold involve an additional expense. The aggregate claimed on this account is the said sum of $1,952.94.

The master (Rec., page 13, Item 7), disallowed this claim, on the ground that,

"the costs of the reconstructed valves have already been charged in the costs of the valves for the periods in which the reconstruction, so called, took place. The old valves were destroyed and a salvage made of such parts as were of value, or could be used, and new valves were made and their full cost charged in the accounts of the

defendants. This Item 7 is a claim for the cost of destroyed valves (whether with or without an allowance for salvage I am unable to say), and should not be allowed."

To this disallowance, the appellants' objection (Rec., pages 27–29) was made; whereupon the master, in his Note 29 (Rec., page 29), modifies his reasons, but reaches the same result. He says:—

"It is clear, upon this statement, that no allowance should be made to the defendants for the sixty-nine valves which they made and destroyed without selling or consigning them. The thirty-eight valves which were originally sold to Babcock & Wilcox were accounted for, both in costs and sales, but when new valves were sent to them to replace the returned valves, the new valves were not included in defendants' account, either in costs or sales. The twelve brass valves were returned, and so treated in the account. The result, therefore, is substantially this: that the defendants made some one hundred and nineteen valves which they subsequently destroyed, with some castings which they concluded not to use. I find no sufficient reasons for modifying my former disallowance of Item 7 in each case."

The master's error is this: The appellants have accounted specifically for all valves which they have made and sold. This will appear in their account (Rec., pages 82–90). If they had sold the sixty-nine valves first referred to in the master's Note 29, they would have accounted for them, but not having sold them they were not the subject of an account. No one disputes this, but the labor that went into such sixty-nine valves became a dead loss to them, as well also as the depreciation in the value of the material entering into such valves on account of its being converted into junk, or the difference between three and a half cents and one cent for iron per pound, and a corresponding proportion for the difference between new brass and old. It must be understood that the appellants buy iron castings, and do not make them. (Rec., page 144, Int. and Ans. 17.) Therefore, they pay in the first instance for a finished product, which when broken up they can sell only for junk. For the loss on this ground the appellants can rightfully claim. The item has not been comprehended, directly or indirectly, in any of the accounts before the master.

As to the thirty-eight valves sold to Babcock & Wilcox, which were replaced with new valves, the appellants were bound to account once for such valves, and it is admitted that they have done so, but when the thirty-eight finished valves were returned by Babcock & Wilcox they were destroyed, and necessarily all the labor involved in them was lost, as well as the depreciation of the material. Unless the appellants are allowed for this, they will be obliged to bear the cost of labor twice over, instead of once. Hence, on these thirty-eight valves they are entitled to charge, as a special loss, the destruction of the labor which went into them, as well as the loss in the conversion of their material from a finished product into junk.

As to the twelve brass valves, they were indeed taken out of the account before the master when they were returned, but they were required to be destroyed; and, as the result of such destruction, the labor put into them was a loss, as well as a depreciation in the material. This item has not anywhere been recouped by the appellants in any portion of the accounts before the master. If the item for the loss on the destruction of the sixty-nine valves not sold, and the loss on destroying thirty-eight valves returned from Babcock & Wilcox, and the loss on the destruction of the twelve brass valves, had been, in the accounts before the master, credited to the appellants in any manner, there would be no ground for this exception; but such is not the fact; and it is because of this fact that there should be an allowance of the item of $1,952.94. Deducting this sum from $40,344.59, the amount found by the master, the balance, to wit, $38.391.65 will then represent the true profits of the appellants' valve business.

And especially do the appellants claim the justice of the allowance of this sum of $1,952.94, in the light of the method adopted by the master in stating his account, for he says (Rec., page 10): —

"The defendants in these cases carried on the manufacture and sale of valves as a continuous business. The valves which they sold at profit and those which they sold at a loss are intermingled. There is no considerable period during which they sold valves at a

profit with no losses, nor is there any considerable period during which they sold valves continuously at a loss. They are entitled to have their entire valve business taken into consideration, in estimating their profits from the infringements complained of, if they have given me the means of determining those profits from their accounts filed and the explanations and evidence which they have offered in relation thereto." . . .

SECOND ERROR.

This relates to the error of the Court in deciding that the master was correct in his conclusion that all the so called "Richardson valves" sold by the appellees contained the invention of Richardson set forth in the said Richardson patent of 1866; whereas it ought to have found that none of the valves sold by the appellees (complainants), during the whole period covered by the accounting of the appellants, did in fact contain the improvement set forth in the said Richardson patent of 1866, and consequently that the so-called Richardson valve sold in the market did not furnish any standard of value for ascertaining the amount of damages or profits to be accounted for by the appellants.

This was in response to the contention that none of the appellees' valves of commerce in fact contained the invention of Richardson, as defined by this Court and as set forth in the patent.

Under the subject of this error was the finding of the master, in which he attributed the entire commercial value of the valves manufactured and sold by the appellants to the improvement covered by Richardson's patent of 1866. (Master's Report, Rec., pages 14, 15.)

The master took the ground that "the Supreme Court has decided in these cases that the defendants' valves contain this invention, and it is under this decision that the accounting in No. 1,184 is before me. Eliminate this invention from the defendants' valves, and they would be commercially worthless."

It is granted that this Court decided that the defendants' (appellants') valves contained the invention of Richardson, but the point under review is, whether the complainants' (appellees') valves of commerce contained the Richardson invention. The determination

of this point becomes of importance, because it affects the whole theory upon which the master has taken the account. The appellants endeavored earnestly to have the master rule that the appellees were bound to show before him what was the value of the Richardson improvement, in comparison with certain prior valves disclosed in the art.

Now, if in fact the complainants' (appellees') valve which they sold commercially had contained the Richardson invention, then the master would have been justified in applying the language commendatory of the Richardson invention as a vital and important one, so as to influence the course of the accounting. But the case is this: This Court interprets the Richardson patent, as appears by its opinion, to be in substance for that improvement over previously existing valves which consists in having the passage for the entrance of the steam into the huddling chamber larger in area than the passage for the exit of the steam into the open air; and it naturally concludes, on the record of the case as it was made before it, that the valves made by the appellees contained that feature, and that the testimony in the record as to the value of the Richardson valves was based upon the fact that the appellees' valves had that characteristic. The point was not taken in this court at all, as to the specific value of a steam valve with a supplementary chamber having apertures of steam entrance greater in area than the apertures for steam discharge. Consequently, when the case comes before a master, the question before him is, What advantage has accrued to the defendants from using the invention set forth in the Richardson patent, as the Court have construed that invention?

The appellants, however, claim that no valve constructed by anybody, known to the art prior to the Crosby valve, contained a feature of construction respecting the supplementary chamber, called a huddling chamber, which is the point of the Richardson improvement, as this Court has construed that patent. Consequently, all the master had before him, in fact, was a paper title to an invention the gist of which was, in comparison with prior structures, that the supplementary steam chamber was a huddling chamber having a small area of exit to the outer air as compared with the area of

the orifice of entrance for the steam. The appellants, by the judgment of this Court, were precluded from taking the position that their valve did not contain this feature, and therefore they did not undertake to show the fact to be different from that which the Court had found, notwithstanding that this specific issue was never made in the record before it. But the appellants did insist that the master, in ascertaining whether the appellants were bound to pay any damages or profits to the appellees for the infringement of the Richardson patent, should ascertain as a fact what the advantages were to steam valves from the introduction of the Richardson improvement, over and above the economic results from steam valves constructed as previously known to the arts.

The appellants not only offered proof, but proved beyond all question, that none of the valves which had been constructed by the appellees professedly under the Richardson patent contained a supplementary steam chamber, or huddling chamber, having the characteristics of the Richardson improvement. Their testimony upon this branch of the case is singularly complete. They introduced specimens of every one of the varieties of valves made by the appellees. It was conceded that this exhibition was correct. The valves produced were made by the appellees. Richardson so testified (*infra*, page 15, Rec., page 224). Thereupon the appellants had the apertures measured accurately, and submitted the clearest proof that in every instance the area of the passage for the entrance of the steam was much less at the ground joint than the area of the exit passage.

The following table of ratios, taken from the testimony of Gen. Burnett (*infra*, page 33, Rec., page 263), exhibits the marked difference between those openings: —

Diameter of Complainants' Valve.	Ratio of Openings in Action. Area at Ground Joint.	Area at lip.
¾ inch	1	2.08
1 "	1	2.13
1¼ "	1	1.76
1½ "	1	1.60
2 "	1	1.77
2¼ "	1	2.11
2½ "	1	1.78
3 "	1	1.67
3½ "	1	2.30
4 "	1	2.12

In a word, the appellees, in making and selling so-called Richardson valves, have only modified the proportions of old and well-known valves, without introducing at all the Richardson improvement as specified on paper in the patent.

The appellees did not question the correctness of this testimony. They could not do so. The valves submitted were of their manufacture and the evidence as to the character of the huddling chamber was capable of being determined by simple accurate measurements. If these measurements submitted by the appellants were incorrect, it was entirely easy for the appellees to show the truth. But they did not attempt to do this. The master, therefore, had not the least authority for his finding that such valves contained the Richardson improvement of 1866, and his finding is directly against the testimony.

The testimony upon this subject is as follows: —

George W. Richardson testified as follows (Record, p. 224): —

Boston, Dec. 28, 1886.

Int. 1. Please state name, residence, and occupation.

Ans. George W. Richardson; Bridgeport, Conn.; superintendent of Consolidated Safety Valve Company.

Int. 2. Are you the person of the same name given in Letters Patent of George W. Richardson filed in this cause?

Ans. I am.

Int. 3. How long have you been employed as superintendent by the Consolidated Safety Valve Company?

Ans. I think it is seven years; ever since its organization.

Int. 4. During this time have you had under your direction the construction of the safety valves made by the Consolidated Safety Valve Company?

Ans. Not directly the construction, but my business has been mostly designing valves and tools.

Int. 5. Are you familiar with the construction and the design of the safety valves made by said company during the time of your superintendency?

Ans. I think I am.

Int. 6. The Consolidated Safety Valve Company, mentioned by you, is the complainant in this case, is it not?

Ans. I believe it is.

Int. 7. Please examine the valves now shown you, and state whether or not they were constructed by the complainant company.

Ans. I think they were; they have our mark or tag on them.

[*Valves shown witness are put in evidence and marked as follows:*

(1) *Defendants' Exhibit Richardson Valves, ¾ in., No.* 102, *J. G. S., Master. This is the valve marked for identification, Oct.* 19, 1886.

(2) *Defendants' Exhibit Complainants' Valve,* 1 *in., No.* 4692, *J. G. S., Master.*

(3) *Defendants' Exhibit Complainants' Valve,* 1¼ *in., No.* 889, *J. G. S., Master.*

(4) *Defendants' Exhibit Complainants' Valve,* 1½ *in., No.* 487, *J. G. S., Master.*

(5) *Defendants' Exhibit Complainants' Valve,* 2 *in., No.* 123, *J. G. S., Master.*

(6) *Defendants' Exhibit Complainants' Valve,* 2½ *in., No.* 148, *J. G. S., Master.*

(7) *Defendants' Exhibit Complainants' Valve,* 3 *in., No.* 188, *J. G. S., Master.*

(8) *Defendants' Exhibit Complainants' Valve,* 3½ *in., No.* 123, *J. G. S., Master.*

(9) *Defendants' Exhibit Complainants' Valve,* 4 *in., No.* 130, *J. G. S., Master.*]

Int. 8. Please examine defendants' Exhibits Complainants' Valves, ¾ in., 1 in., 1¼ in., 1½ in., 2 in., 2½ in., 3 in., 3½ in., 4 in., and also defendants' Exhibit 14, Richardson Valve, and complainants' Exhibit C (the last two mentioned in the record in this case), and state whether or not they differ from safety valves of corresponding size made and sold by the complainants during the time from the origin of the company to Jan. 31, 1885.

Ans. They do differ materially from valves made at the origin of the company. There are improvements, in different parts of the valve and case combined, from valves made at that time.

Int. 9. Please examine defendants' Exhibit Complainants' Valve 4 in., and point out any difference in that valve from 4-in. valves made by the complainant company during the period named, excluding in your answer the shell or case, the lever, spring, pintle and

other accessories which may hold to or remove the valve from its seat.

Ans. There is a little difference in the form of the annular chamber from the valves made at the time spoken of, but the principle and action of the valves are very nearly the same.

Int. 10. Please describe that difference of form of the annular chamber.

Ans. The annular chamber in the valve proper is more nearly square in the top than in the ones made at the time referred to. It also has intermediate wings or braces.

Int. 11. The words in your answer to Int. 9, "very nearly," am I to understand to mean substantially?

Ans. I mean that I like this valve better than the other; if I didn't I shouldn't make them this way.

Int. 12. Please define what you mean by "very nearly."

Ans. I mean that each one of them has an annular chamber of very nearly the same size, all the difference being in form. The action is very nearly alike; I like the action of this better than the other somewhat.

Int. 13. Please consider the complainants' valves 3½ in., 3 in., 2½ in. and 2 in. in the same way as you have just considered the 4 in. under Int. 9.

Ans. Without taking the valves apart, I should answer the same.

Int. 14. Do you wish them taken apart?

Ans. Not unless you do.

Int. 15. The valves having been taken apart, please to answer Int. 13.

Ans. All of the exhibits except the 2 in., No. 128, have the difference spoken of with regard to the 4-in. valve. The 2-in. valve has the annular chamber and adjustable ring of the same style as we made, as near as I can recollect, but I may forget some parts of it.

Int. 16. That difference mentioned is in the form of the annular chamber which you have given, is it?

Ans. It is.

Int. 17. Please examine defendants' Exhibit 14, and complainants' Exhibit C, and in considering them exclude all but the valve body or bush and the valve proper. Then please state whether or not they differ from the 2½-in. valves or locomotive valves made and sold by the complainants from Feb. 15, 1879, to Jan. 31, 1885.

Ans. I think they are virtually the same.

Int. 18. Please examine complainants' valves ¾ in., 1 in., 1¼ in. and 1½ in., excluding the cases, lever arrangements and lock-up attachments, and state in what respects, if any, they differ from valves of corresponding sizes made and sold by complainants during the period named in the last question.

Ans. I think they embody the same general features as the valves referred to in the last question.

Int. 19. Between the said ¾-in. valve and the 4-in. valve which have been testified of, were there any sizes of valves during the period named, other than the sizes already given, made and sold by the complainants?

Ans. I don't remember any.

Int. 20. During that period, were there not valves larger than 4 in. made and sold by complainants?

Ans. There were, I think, 4½, 5, 5½ and 6 in.

Int. 21. Were these valves made substantially, as to the valve body or bush and the valve proper, like defendants' Exhibit Complainants' Valve 4 in., except as to size?

Ans. Not all of them; I think we made some special valves with slight differences which I can't just recollect now, but, as I understand it, most of them were.

Cross Examination by T. W. CLARKE, Esq., *of Counsel for Complainants.*

Cross-Int. 22. Do the valves which have been produced, ranging from ¾ in. to 4 in., include all the styles or classes of safety valves, embodying substantially the construction of valve body and valve proper here represented in the valves produced, which you made during the period from the formation of the Consolidated Valve Company to Jan. 31, 1885; and, if not, what other classes than those produced were so made by said company?

Ans. I think they include all.

Cross-Int. 23. Then you made no other sizes of brass-cased valves and no other styles of brass-cased valves than the four sizes and style here before you, ranging from ¾ in. to 1½ in., did you?

Ans. We did; we made 2 in., 2¼ in., 2½ in. and 3 in., and perhaps other sizes, which I do not remember. I didn't understand the question before to include exact sizes. We also made other styles of brass-cased valves.

Cross-Int. 24. Did you make any smaller sizes of iron-cased valves than 2 in.?

Ans. We did; as small as down to ¾ in., 1½, 1¼, 1 and ¾ in., I think.

Cross-Int. 25. And did you make any other styles of iron case for any of these sizes of iron valves, from ¾ in. to 6 in., than the iron case with a side outlet?

Ans. I think we did make some cases with a top plain outlet and some with a top screwed outlet, to attach a pipe to.

Cross-Int. 26. Did you make any other shape of iron case than the one here produced?

Ans. We did.

Cross-Int. 27. Did you make any other sizes of unencased valves than 2¼ in.?

Ans. I think we might have made some on special orders; I feel very sure we did.

Cross-Int. 28. You have said that you liked the action of the valve with the angular annular chamber better than the action with the other chamber somewhat. What is there in the action of the two valves which makes you like that of the one more than the other?

Ans. In testing the valves with steam, I think they test a little easier; or, in other words, I can test more of them in a given time.

Cross-Int. 29. In these other sizes and styles of brass valves you have spoken of, has there been any substantial difference in the construction of the valve proper, of the bush and of the adjustable ring, from what is shown in the brass valves now before you?

Ans. We did make some valves, when I first went to work for the company, with a top outlet and a lever, where the valve was constructed like the valve on page 14 of complainants' catalogue of 1879.

Cross-Int. 30. Other than the valves like the picture on page 14, were your brass valves arranged with valves proper, bushes and adjustable rings, in substantial likeness to those of the brass valves before you, namely, ¾, 1, 1¼ and 1½ in.?

Ans. As I understand it, they were.

Cross-Int. 31. Now, as to the other iron-cased valves which you made of smaller and larger sizes than the iron-cased valves from 2 to 4 in. inclusive before you, were they arranged with bushes, valves proper and adjustable rings, substantially similar to those of these iron valves from 2 in. to 4 in. inclusive?

Ans. When I first went to work for the company, I made some valves like that pictured on page 7 of complainants' catalogue of 1879, arranged with an adjustable ring; but just as fast as I could change the pattern, I made them substantially like those before me.

TESTIMONY OF MESSRS. HARRISON, BURNETT AND RENWICK.

The valves which were identified and admitted by Mr. Richardson as being the type of safety valves made and sold by the complainants during the time of the accounting, were submitted to Messrs. Harrison and Burnett, witnesses produced by the defendants, for their examination, measurement and trial. Mr. Harrison testified as follows:—

[Record, p. 228.]

Int. 25. Examine the following defendants' Exhibits Richardson Valve ¾ in., No. 104; Complainants' Valves 1 in., No. 4,692; 1¼ in.,

No. 889; 1½ in., No. 487; 2 in., No. 123; 2½ in., No. 148; 3 in., No. 188; 3½ in., No. 123; 4 in., No. 130; and defendants' Exhibit 14 and complainants' Exhibit C, and state whether or not you have obtained the dimensions of the valve body and valve proper of each and of other parts which will disclose the openings and the peculiar features of these valves, and tested them.

Ans. I have examined them, and taken the measurements and tested them.

Int. 26. What was the condition of all these valves just mentioned except the ¾-in. and defendants' Exhibit 14 and complainants' Exhibit C, when they came to your possession for trial, so far as their external appearance is concerned?

Ans. The apparent condition of all was that of new valves sent out from the shop ready for use. Lead seals were in their places on the heads of the brass valves, and the brass tag and wire which form a seal on the iron valves were also in their places, and unbroken.

Int. 27. Was this condition changed when you made the tests of them?

Ans. It was not.

Int. 28. Will you describe in what way and how you tested them?

Ans. In the case of the brass valves, I drilled a hole in the top of the cap for the purpose of inserting a wire to determine the amount of the lift of the valve when in action. In the case of the iron valves, I made no change, but tested them as they stand here. After completing my recorded tests of their action, I removed the top and lever for the purpose of determining the amount of the lift of the valve when in action. The valves were connected to a large testing boiler at the Crosby Gage Company's works, and the results of their action noted.

Int. 29. Were these valves, sealed as you have described, taken by you and placed on the boiler spoken of, and allowed to operate without any manipulation whatever on your part?

Ans. Yes, sir.

Int. 30. Do all these exhibits, with the exception of defendants' Exhibit 14 and complainants' Exhibit C, have indicated upon them the pressures at which they were set to open and close? If so, please give what is stated in that regard on each.

Ans. On the ¾-in. brass valve there is stamped, "Set 100." I understand that to mean that the valve is to open when the boiler pressure reaches 100 lbs. to a square inch.

The 1-in. valve is stamped, "Set 100."

The 1¼-in. valve is stamped, "Set 100."

The 1½-in. valve is stamped, "Set 100."

The 2-in. valve is stamped on its brass tag, "Pops at 80, closes

at 77." This I interpret to mean that the spring of this valve is so adjusted that the valve will open when the steam pressure in the boiler has reached 80 lbs., no more and no less, and also that the valve will close when the steam pressure in the boiler has decreased to 77 lbs., no more and no less.

The 2½-in. valve has stamped on its tag, "Pops at 80, closes at 77."

The 3-in. valve has stamped on its tag, "Pops at 80, closes at 77."

The 3½-in. valve has stamped on its tag, Pops at 80, closes at 77."

The 4-in. valve has stamped on its tag, "Pops at 80, closes at 77."

Int. 31. When you made the trials of these valves, did you know as to the accuracy of the steam gauge used to indicate the results?

Ans. I tested the gauge in comparison with the standard gauge of the Crosby Steam Gage and Valve Company, and found it to be correct.

Int. 32. Please give the dimensions of Richardson valve, ¾ in., No. 104, and the result of the trial which you observed of it.

Ans. I give the following dimensions: —

Diameter of steamway	.75 inch.
" at top of ground joint	.84 "
" at outside of upper edge of adjustable ring .	1.08 "
" at inside edge of lip	1.11 "
Horizontal width of outlet at lip	.015 "

There is no overlap, as daylight is visible in a fine line under the lip.

The spring is composed of 8½ turns of steel, $\frac{3}{16}$ in. square. The outside diameter of the spring is 1.20 in. Its length when free, 2.60 in.; length when compressed to working pressure, 2.43 in.; compression at 100 pounds, .17 in.

With this valve and spring, on Saturday, Oct. 23, 1886, I made a test, the results of which are set forth in the accompanying table: —

MR. HARRISON'S TEST OF RICHARDSON VALVE, ¾ INCH, No. 104.

Lift of valve.	STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Inches.	Warn.	Pop.	Close.	Reduction.
.03	99	100	97	3
"	99	100	97	3
"	99	100	97	3
"	99	100	97	3

Int. 33. Give the dimensions of defendants' Exhibits Complainants' Valves, 1 inch, No. 4,692; 1¼ inch, No. 889; 1½ inch, No.

487; 2 inch, No. 123; 2½ inch, No. 148; 3 inch, No. 188; 3½ inch, No. 123; 4 inch, No. 130, and the result of the test of each.

Ans. (1) 1-inch valve, No. 4,692; dimensions are: —

Diameter of steamway	1 inch.
" at top of ground joint	1.10 "
" at outside of upper edge of adjustable ring	1.37 "
" at inside edge of lip	1.44 "
Horizontal width of outlet at lip	.035 "
Overlap	.03 "

The spring is composed of 7½ turns of steel, $\frac{3}{16}$ inch square; outside diameter of spring, 1.25 inches; length when free, 2.90 inches; length when compressed to working pressure, 2.69 inches; compression at 95 lbs., .21 inch.

Result of test, Monday, Oct. 4, 1886, is shown in the following table: —

MR. HARRISON'S TEST OF COMPLAINANTS' VALVE, 1 INCH, No. 4,692.

Lift of valve.		STEAM PRESSURES IN POUNDS PER SQUARE INCH.		
Inches.	Warn.	Pop.	Close.	Reduction.
.03	No warning.	96	94.5	1.5
"		96	94.5	1.5
"		96	94.5	1.5
"		95	92.5	2.5
"		93.5	92	1.5
"		93.5	92	1.5

(2) 1¼-inch valve, No. 889; dimensions are: —

Diameter of steamway	1.26 inches.
" at top of ground joint	1.38 "
" at outside of upper edge of adjustable ring	1.76 "
" at inside edge of lip	1.85 "
Horizontal width of outlet at lip	.045 "
Overlap	.035 "

The spring is composed of 8½ turns of steel, .20 inch square; outside diameter of spring, 1.35 inches; length when free, 2.90 inches; length when compressed to working pressure, 2.69 inches; compression at 99 pounds, .21 inch.

Result of test, Monday, Oct. 4, 1886, is shown in the following table: —

MR. HARRISON'S TEST OF COMPLAINANT'S VALVE, 1¼ INCH, No. 889.

Lift of valve.		STEAM PRESSURES IN POUNDS PER SQUARE INCH.		
Inches.	Warn.	Pop.	Close.	Reduction.
.05	..	99	94.5	4.5
"	..	98.5	94	4.5
"	..	99	94	5
"	..	97.5	94	3.5
"	..	99	92	7

(3) 1½-inch valve, No. 487; dimensions are: —

Diameter of steamway	1.50	inches.
" at top of ground joint	1.65	"
" at outside of upper edge of adjustable ring	2.07	"
" at inside edge of lip	2.14	"
Horizontal width of outlet at lip	.035	"
Overlap	.02	"

The spring is composed of 7 turns of steel, .20 in. square; outside diameter of spring, 1.25 in.; length when free, 2.85 in.; length when compressed to working pressure, 2.57 in.; compression at 96½ lbs., .28 in.

Result of test is shown in the following table: —

MR. HARRISON'S TEST OF COMPLAINANTS' VALVE, 1½ INCH, NO. 487.

Lift of valve.	STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Inches.	Warn.	Pop.	Close.	Reduction.
.07	No warning.	99.5	92.5	7
"	"	96	92.5	3½
"	"	96.5	92.5	4
"	"	96.5	92.5	4
"	"	96.5	92.5	4
"	"	96.5	92.5	4
"	"	96.5	92.5	4

(4) 2-inch valve, No. 123; dimensions are: —

Diameter of steamway	2.01	inches.
" at top of ground joint	2.18	"
" at outside of upper edge of adjustable ring	2.67	"
" at inside edge of lip	2.73	"
Horizontal width of outlet at lip	.03	"
Overlap	.01	"

The spring is composed of 6½ turns of steel, .28 inch square; outside diameter of spring, 1.75 inches; length when free, 3.85 inches; length when compressed to working pressure, 3.60 inches; compression at 76 pounds, .25 inch.

Result of test is shown in the following table: —

MR. HARRISON'S TEST OF COMPLAINANTS' VALVE, 2 INCH, NO. 123.

Lift of valve.	STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Inches.	Warn.	Pop.	Close.	Reduction.
.05	75.5	78	74	4
"	76	78	74	4
"	76	76.5	74	1.5
"	75.5	76	74	2
"	75.5	76	74	2
"	No.	76	74	2
"	warning.	76	74	2
"		76	74	2

(5) 2½-inch valve, No. 148; dimensions are: —

Diameter of steamway	2.51 inches.
" at top of ground joint	2.69 "
" at outside of upper edge of adjustable ring	3.37 "
" at inside edge of lip	3.47 "
Horizontal width of outlet at lip	.05 "
Overlap	.02 "

The spring is composed of 7½ turns of steel, ⅝ inch square; outside diameter of spring, 2.28 inches; length when free, 4.88 inches; length when compressed to working pressure, 4.48 inches; compression at 76½ pounds, .40 inch.

Result of test is shown in the following table: —

MR. HARRISON'S TEST OF COMPLAINANT'S VALVE, 2½ INCH, No. 148.

Lift of valve.	STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Inches.	Warn.	Pop.	Close.	Reduction.
.08	No	76.5	74.5	2
"	warning.	76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"
"		76.5	74.5	"

(6) 3-in. valve, No. 188; dimensions are: —

Diameter of steamway	3.01 inches.
" at top of ground joint	3.25 "
" at outside of upper edge of adjustable ring	4.18 "
" at inside edge of lip	4.26 "
Horizontal width of outlet at lip	.04 "
Overlap	.02 "

The spring is composed of 7 turns of steel, $\frac{7}{16}$ inch square; outside diameter of spring, 2.40 inches; length when free, 4.95 inches; length when compressed to working pressure, 4.65 inches; compression at 77½ lbs., .30 inch.

Result of test is shown by the following table: —

MR. HARRISON'S TEST OF COMPLAINANTS' VALVE, 3 INCH, No. 188.

Lift of valve.	STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Inches.	Warn.	Pop.	Close.	Reduction.
.08	75.5	77.5	75	2.5
"	76	77.5	75	2.5
"	75.5	77.5	74.5	3
"	75.5	77.5	74.5	3
"	75.5	77.5	74.5	3

(7) 3½-in. valve, No. 123; dimensions are: —

Diameter of steamway	3.51	inches.
" at top of ground joint	3.72	"
" at outside of upper edge of adjustable ring	4.84	"
" at inside edge of lip	4.92	"
Horizontal width of outlet at lip	.04	"

No overlap. There is, however, a clearance of .01 in. which the lower edge of the lip is above the top edge of adjustable ring.

The spring is composed of 6½ turns of steel, ½ inch square; outside diameter of spring, 3.15 inches; length when free, 5.40 inches; length when compressed to working pressure, 5 inches; compression at 76½ pounds, .40 inch.

Result of test is shown by the following table: —

MR. HARRISON'S TEST OF COMPLAINANTS' VALVE, 3½ INCH, NO. 123.

Lift of valve.	STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Inches.	Warn.	Pop.	Close.	Reduction.
.08	No	76	73	3
"	warning.	76	73.5	2.5
"		76	73.5	2.5
"		76	73.5	2.5
"		77	73.5	3.5
"		76	73.5	2.5
"		77.5	73.5	4
"		76.5	73.5	3
"		76.5	73.5	3

(8) 4-inch valve, No. 130; dimensions are: —

Diameter of steamway	3.99	inches.
" at top of ground joint	4.21	"
" at outside of upper edge of adjustable ring	5.60	"
" at inside edge of lip	5.66	"
Horizontal width of outlet at lip	.03	"

Overlap taken as nothing, daylight being visible in a fine line between the lower edge of lip and the upper edge of the adjustable ring.

The spring is composed of six turns of steel, $\frac{9}{16}$ inch square; outside diameter of spring, 3.50 inches; length when free, 5.95 inches; length when compressed to working pressure, 5.50 inches; compression at 77½ lbs., .45 inch.

Report of test is shown by the following table: —

MR. HARRISON'S TEST OF COMPLAINANTS' VALVE, 4 INCH, No. 130.

Lift of valve.	STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Inches.	Warn.	Pop.	Close.	Reduction.
.06	77	78	74	4
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5
"	76.5	77.5	74	3.5

Int. 34. Give the dimensions of defendants' Exhibit 14 and complainants' Exhibit C, and the result of the test of each.

Ans. The dimensions of defendants' Exhibit 14 are: —

Diameter of steamway	2.26 inches.
" at top of ground joint	2.54 "
" at outside of valve seat at upper edge	3.18 "
" of the inside of adjustable lip at lower edge	3.28 "
Horizontal width of outlet at lip	.05 "
Overlap	.02 "

The spring is composed of 7 turns of steel, $\frac{3}{8}$ inch square; outside diameter of spring, 2.20 inches; length when free, 4.10 inches; length when compressed to working pressure, which was 100 lbs., 3.80 inches; compression at 100 lbs., 30 inches; length when set for 123 lbs. working pressure, 3.70 inches; compression at 123 lbs., .40 inch.

There were two sets of experiments made with this valve: one with a boiler pressure of 100 lbs., and the other with a boiler pressure of 123 lbs., the results of which are fully set forth in the following table: —

MR. HARRISON'S TESTS OF DEFENDANTS' EXHIBIT 14.

Remarks.	Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Tested at 100 pounds per square inch boiler pressure.	.03	No warning.	100	$99\frac{1}{2}$	$\frac{1}{2}$
	"	"	100	$99\frac{1}{2}$	$\frac{1}{2}$
	"	"	100	$99\frac{1}{2}$	$\frac{1}{2}$
	"	"	100	$99\frac{1}{2}$	$\frac{1}{2}$
	"	"	100	$99\frac{1}{2}$	$\frac{1}{2}$
The spring was then tightened, and boiler pressure ran up to 123 pounds, and these results obtained.	.03	No warning.	123	119	4
	"	"	123	119	4
	"	"	123	119	4
	"	"	123	119	4
	"	"	123	119	4
	"	"	123	119	4

As to complainants' Exhibit C, I notice that this valve has no adjustable feature for its overlap. Its dimensions are: —

Diameter of steamway	2.25 inches.
" at top of ground joint	2.55 "
" at outside of top of valve seat	3.17 "
" at inside of lower edge of lip	.328 "
Horizontal width of outlet at lip	.055 "
Overlap	.03 "

The spring is composed of 7½ turns of steel, .36 inch square; outside diameter of spring, 2.25 inches; length when free, 4.44 inches; length when compressed for working pressure of 100 pounds, 3.94 inches; compression at 100 pounds, .50 inch = ½ inch; compression of spring with a working pressure of 123 pounds, .625 inch = ⅝ inch.

With this valve I made two sets of experiments: one at 100 pounds, and the other at 123 pounds boiler pressure. The results are shown by the following table: —

MR. HARRISON'S TESTS OF COMPLAINANTS' EXHIBIT C.

REMARKS.	Lift of valve. Inches.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Spring compressed ½ inch.	.05	No warning.	100	97	3
	"	"	100	97	3
	"	"	100	97	3
	"	"	100	97	3
	"	"	100	97	3
Spring compressed ⅝ inch to make valve pop at 123.	.05	No warning.	123	114½	8½
	"	"	123	114½	8½
	"	"	123	114½	8½

Int. 35. Have you compiled a table of like dimensions of the valves testified of in the last three questions, and of corresponding dimensions of defendants' Exhibits Richardson Valve like Photo-lithograph Drawing, and Richardson Valve from Original Drawing? If so, please produce it and make it part of your answer.

Ans. I have, and I produce it. It is as follows: —

TABLE OF DIMENSIONS OF RICHARDSON'S AND COMPLAINANTS' VALVES.

DIAMETERS IN INCHES.

NAME OF VALVE.	Steamway.	Top of ground joint.	Outside of valve seat.	Inside of lip.	Width of outlet.	Overlap.	Remarks.
Defendants' Exhibit Richardson valves like photolithograph drawing.	1.34	1.65	1.94	1.96	.01	.025	
Defendants' Exhibit Richardson valve from original drawing, 1866.	2½	2.73	3.228	3.26	.016	.03	
			Outside adjustable ring on valve body.				
Consol. Valve Co.	¾	.84	1.08	1.11	.015	.00	
" " "	1	1.10	1.37	1.44	.035	.03	
" " "	1¼	1.38	1.76	1.85	.045	.035	
" " "	1½	1.65	2.07	2.14	.035	.02	
" " "	2	2.18	2.67	2.73	.03	.01	
Defend. Exhibit 14.	2½	2.54	3.18	3.28	.05	.02	Ring on lip.
Comp. " C.	2½	2.55	3.17	3.28	.055	.03	No ring.
Consol. Valve Co.	2½	2 69	3.37	3.47	.05	.02	
" " "	3	3.25	4.18	4.26	.04	.02	
" " "	3½	3.72	4.84	4.92	.04	.00	Clear-
" " "	4	4.21	5.60	5.66	.03	.00	ance.

Int. 36. Have you also compiled a table showing in defendants' Exhibits of Richardson's and Complainants' Valves and complainants' Exhibit C, above mentioned, the size, the operation under steam, the lift of the valve at such time, and the area of the openings, both at the ground joint and at the outlet, and the ratio of those two openings? If so, please produce it, and make it part of your answer.

Ans. I have, and I produce it. It is as follows:—

TABLE OF AREAS OF OPENINGS.

Diameter of Steamway.		Lift of Valve, Inches.	AREAS OF OPENINGS, IN SQUARE INCHES.			STEAM PRESSURE IN BOILER, IN POUNDS, PER SQUARE INCH.		
			At ground joint.	At outlet.	Ratio.	Open.	Close.	Reduction.
1.34	Defendants' Exhibit Richardson valve like photolithograph drawing.	.05	.1805	.1649	1 : .91	100	72½	27½
2½	Defendants' Exhibit Richardson valve from original drawing, 1866.	.0555	.3562	.3026	1 : .86	100	71	29
¾	Con. Valve Co.	.03	.0560	.1154	1 : 2.06	100	97	3
1	" " "	.03	.0730	.1545	1 : 2.10	93½	92	1½
1¼	" " "	.05	.1533	.2688	1 : 1.75	99	94	5
1½	" " "	.07	.2564	.4036	1 : 1.57	96½	92½	4
2	" " "	.05	.2420	.4240	1 : 1.75	76	74	2
2½	Def. Ex. 14.	.03	.1693	.5175	1 : 3.05	100	99½	½
2½	Comp. Ex. C.	.05	.2832	.5926	1 : 2.09	100	97	3
2½	Con. Valve Co.	.08	.4780	.8391	1 : 1.75	76½	74½	2
3	" " "	.08	.5744	.9560	1 : 1.66	77½	74½	3
3½	" " "	.08	.6610	.1507	1 : 2.28	76½	73½	3
4	" " "	.06	.5610	.1186	1 : 2.11	77½	74	3½

Int. 37. The complainants' valve, 1 to 4 inches, you have said you tested without disturbing as received. Now the ¾-inch valve and defendants' Exhibit 14 and complainants' Exhibit C were not set at any particular pressure when you made your trials, were they? And, if not, at what pressure did you set them?

Ans. They were not. I set the ¾-inch valve to pop at 100 lbs. boiler pressure, defendants' Exhibit 14 at 100 lbs. boiler pressure in one series of experiments and at 123 lbs. in the other series, and complainants' Exhibit C at 100 lbs. in one series and at 123 lbs. in the other series of experiments.

Int. 38. When did you make the measurements of the Richardson's and complainants' valves?

Ans. On the days following the experiments.

Int. 39. How did you get at the valves to make those measurements?

Ans. In the brass valves, by unscrewing the case from the castings of the seat without disturbing the top part of the valve; that is, the measurements of the valves. In the iron-cased valves, it was necessary to withdraw the screw plug which serves as a keeper for preventing accidental disturbance of the adjustment of the adjustable ring; then, by taking out the bolts from the flange, I was enabled to lift the valve case bodily from the lower iron casting of the valve without changing the adjustment of the ring.

Int. 40. Could you then get at all parts of the valve and body?

Ans. I could.

Int. 41. On the brass valves, how are the adjustable rings spoken of by you located and held in place?

Ans. They are located on the valve seat casting, and surrounding it. They are held in place by a brass wire which is driven through a suitable notch, provided for that purpose when the valve is made, into the seat.

Int. 42. Whether or not those rings or fastenings were ever disturbed, or have been disturbed?

Ans. They have not.

Int. 43. As to the iron valves, where is the adjustable ring located on them, and how is it held in place?

Ans. It surrounds the brass casting which forms the valve seat, and is held in place by a screw plug, as I have before described.

Int. 44. After the measurements were made, who assembled and put the parts of valves together?

Ans. I did.

Int. 45. Whether or not there was any change of these parts from their location or position, when received and tested by you.

Ans. There was no change.

Int. 46. How did you find the area of the opening at the ground joint, which has been already given for each valve?

Ans. The Richardson valves, I took the diameter at top of the ground joint and subtracted from that half the lift; then from that remainder, I calculated the mean circumference of the opening. This circumference, multiplied by the width of the opening, gives the area at the ground joint; and the width of opening was calculated by multiplying the lift of the valve by the natural sine of the angle of the valve face from a perpendicular. This angle for the small valve was taken at 45 degrees, and the natural sine of 45 degrees is .707. The angle of the valve face from a perpendicular in the Richardson valve, made from the original drawing, was 50 degrees, and the natural sine of an angle of 50 degrees is .766.

In my calculations on the Consolidated Valve Company's valves, ¾ in. to 4 in., inclusive, and also defendant's Exhibit 14, and complainants' Exhibit C, I took the actual diameter at top of the ground joint, and from that diameter calculated the circumference without making any reduction. This circumference so taken, multiplied by the width of opening, gives an approximate area which does not exceed the true area more than 2 per cent. The angles of all these valves were taken as being 45 degrees. Some of them vary slightly from that, but not to any great extent.

Int. 47. When you put these valves together, after making the measurements, did you deliver them to Mr. William Burnett for trial, and were you present at a trial of them by him?

Ans. I did deliver them to him, and was present at a trial.

Int. 48. Whether or not they were in the same condition when so delivered as to location of all the parts as when you made tests with them?

Ans. They were.

GEN. BURNETT testified as follows (Rec., p. 263): —

Int. 1. Please state your name, age, residence and occupation.

Ans. William Burnett; sixty-one; New York City; consulting mechanical engineer.

Int. 2. You are the person of the same name who testified in this case at the Rules?

Ans. Yes, sir.

Int. 3. Did you receive from William H. Harrison any safety valves to be tested by you at a recent date?

Ans. Yes, sir.

Int. 4. Examine defendant's Exhibits Richardson Valve ¾ in., No. 104; Complainants' Valves, 1 in., No. 4,692; 1¼ in., No. 889; 1½ in., No. 487; 2 in., No. 123; 2½ in., No. 148; 3 in. No. 188; 3½ in., No. 123; and 4 in., No. 130; and complainants' Exhibit C, and state whether or not they are the ones so received by you.

Ans. They are.

Int. 5. When and where did you make any tests of these valves?

Ans. The tests were made on the 10th and 11th of December last, at the works of the Crosby Steam Gage and Valve Company, in Boston.

Int. 6. What was the condition and capacity of the steam boiler upon which you made your tests, having in view the size and character of the valves to be tested?

Ans. I found it of sufficient capacity for the purpose of testing these valves.

Int. 7. In making the tests, at what pressures did you set the valves?

Ans. At the pressures stated on the tags attached by the manufacturer, or as I understood were so attached.

Int. 8. In the case of those complainants' valves not so tagged, at what pressures were they set?

Ans. At the pressures stamped upon their casings; the 2¼-inch valve, being complainants' Exhibit C, not stamped for any particular pressure, was tested at one hundred pounds.

Int. 9. At the tests made, whether or not you obtained in each case the lift of the valve?

Ans. I did.

Int. 10. Were these valves at the time of and before the test ready and in a condition to be attached for trial?

Ans. They were.

Int. 11. Whether or not you obtained from them by measurement the dimensions of those parts of the valves relating to the valve proper and valve body or bush; if so, when, before or after the trial?

Ans. The parts were measured very carefully after the trial was made.

Int. 12. Will you please give the result of the tests made by you of these valves, showing the lift of each valve, the amount of opening and closing in pounds pressure at which each valve opened and closed, the dimensions obtained by you of each valve, a computation derived from these dimensions showing the opening at the ground joint and the opening at the lip of each valve, and the ratio of such openings?

[*Objected to as incompetent and irrelevant on any issue of this accounting, and on various grounds heretofore interposed to similar questions propounded to Mr. Harrison. Action of the master upon this objection is reserved to the draft and final reports, and all the rights of the parties respectively are also reserved.*]

Ans. The items obtained by means of these tests, and which were acquired by very close measurements of the parts and calculations based upon such measurements and tests, were: —

1. Diameter of steamway of each valve.
2. Diameter of top of ground joint.
3. Diameter of inside of lip.
4. Diameter of outside adjustable ring or valve seating.
5. Horizontal width of outlet at lip.
6. Mean diameter of opening at lip.
7. Lift of valve under steam.
8. Overlap of valve at lip.
9. Effective diameter at ground joint.
10. Effective diameter at lip.
11. Width of opening at ground joint.
12. Width of opening at lip.
13. Area of opening at ground joint.
14. Area of opening at lip.
15. Ratio of openings, ground joint to lip.
16. Pressure at which the valve opened under steam.
17. Pressure at which the valve closed with steam.
18. Loss of pressure in pounds.

The ratio of openings, ground joint to lip, I find to be in the 4-inch valve, 1 to 2.12; in the 3½-inch valve, 1 to 2.30; in the 3-inch valve, 1 to 1.67; in the 2½-inch valve, 1 to 1.78; in the 2¼-inch valve, 1 to 2.11; in the 2-inch valve, 1 to 1.77; in the 1½-inch valve, 1 to 1.60; in the 1¼-inch valve, 1 to 1.76; in the 1-inch valve, 1 to 2.13; in the ¾-inch valve, 1 to 2.08.

I have all the data obtained and in tabular form, and now present it to be entered as part of my answer, in the record, as follows: —

BURNETT'S TABLE OF TESTS AND MEASUREMENTS.

	NOMINAL DIAMETER OF SAFETY VALVES.	4"	3 1-2"	3"	2 1-2"	2 1-4"	2"	1 1-2"	1 1-4"	1"	3-4"
1.	Diameter of steamway.....	3.99	3.51	3.01	2.51	2.25	2.01	1.50	1.26	1	.75
2.	" top of ground joint.....	4.21	3.72	3.25	2.69	2.55	2.18	1.65	1.38	1.10	.84
3.	" inside of lip.....	5.66	4.92	4.26	3.47	3.28	2.73	2.14	1.85	1.44	1.11
4.	" outside adjustable ring, or valve seating.....	5.60	4.84	4.18	3.37	3.17	2.67	2.07	1.76	1.37	1.08
5.	Horizontal width of outlet at lip.....	.03	.04	.04	.05	.055	.03	.035	.045	.035	.015
6.	Mean diameter of opening at lip.....	5.63	4.88	4.22	3.42	3.225	2.70	2.105	1.805	1.405	1.095
7.	Lift of valve.....	.06	.08	.08	.08	.05	.05	.07	.05	.03	.03
8.	Overlap of valve at lip.....	.000	—.01	.02	.02	.03	.01	.02	.035	.03	.000
9.	Effective diameter at ground joint.....	4.18	3.68	3.21	2.65	2.525	2.155	1.615	1.355	1.085	825
10.	Effective diameter at lip.....	5.63	4.88	4.22	3.42	3.225	2.70	2.105	1.805	1.405	1.095
11.	Width of opening at ground joint.....	.04242	.05656	.05656	.05656	.03535	.03535	.04949	.03535	.02121	.02121
12.	Width of opening at lip.....	.06708	.0984	.0721	.0781	.0585	.05	.06103	.0474	.035	.0335
13.	Area of opening at ground joint.....	.5569	.6538	.5701	.4705	.2803	.2393	.2510	.1504	.0722	.0549
14.	Area of opening at lip.....	1.1859	1.5084	.9553	.8387	.5926	.4240	.4035	.2687	.1544	.1142
15.	*Ratio of openings.* — Ground joint to lip	1.—2.12	1.—2.30	1.—1.67	1 —1.78	1.—2.11	1.—1.77	1.—1.60	1.—1.76	1.—2.13	1.—2.08
	Tag No. — or stamped..	130	123	188	148	*	123	487	889	4692	104
16.	*Trial under steam.* — Valve opened at	80	80	80	80	100	80	100	100	100	100
17.	" closed at.....	76	76.5	76.5	76.75	98	78	94.75	94	96.5	96.5
18.	With *loss of pressure* in pounds.....	4	3.5	3.5	3.25	2	2	5.25	6	3.5	3.5

* Complainants' Exhibit C.

Int. 13. What is to be understood by the statement, "effective diameter at ground joint?"

Ans. It is that diameter which represents the true opening by the ground joint as found by subtracting from the upper diameter of the ground joint one half the lift of the valve.

Int. 14. In statement "8. Overlap of valve at lip," where the sign minus occurs before the figures, how does that indicate the location of the lip in relation to extended valve seat?

Ans. In general, the amount of overlap is expressed with reference to the valve seating as exceeding that; and, from the introduction of this minus sign, it is intended to express that there is not only no overlap, but less than no lap by the amount expressed in the figures.

Int. 15. Considered upon the horizontal plane of the extended valve seat, where does the lower edge of lip then come?

Ans. At some distance above the edge of the seating.

Int. 16. How did you obtain the "width of opening at ground joint," as found in statement 11?

Ans. Multiplied the lift of the valve by the sine of the angle of the seat, which is .707.

Int. 17. At what stage in the operation of the valve do the statements 9, 10, 11, 12, 13, 14 and 15 indicate?

Ans. When the valve is fully lifted under steam pressure.

Int. 18. This full lift is found in the case of each valve in statement 7, is it not?

Ans. Yes, sir.

Int. 19. When you obtained the diameters of the valves at the valve seating, as shown in statement 4, whether or not there had been any change of what is called there "the adjustable ring" from its condition at the time of the test.

Ans. The measurements were made after the test; there was no change from time of testing to the time of measuring them.

Int. 20. Have you read the opinion of the Supreme Court in this case, and do you understand the mechanical description therein by the Supreme Court of the Richardson valve?

Ans. I have and do.

Int. 21. Please compare each and all of the valves, and generally, if it can be so done, which you tested with the safety valve described in the Richardson patent of 1866, according to the mechanical description given by the Supreme Court of the Richardson invention, limiting your comparison to that portion of the valves tested embracing the valve proper, the body and the attachments.

Ans. All the valves which I tested in their essential features have the general appearance of conformity to the Richardson valve, as described in the decision of the Supreme Court; while, in fact, there are wide and essential differences, and especially in regard to

the comparative size of openings required as between the ground seat of the valve and the strictured orifice at the lip of the valve.

The Court say: —

"Richardson is, therefore, entitled to cover, by the claim of his patent of 1866, under the language, 'a safety valve with the circular or angular flange or lip *cc*, constructed in the manner, or substantially in the manner, shown, so as to operate as and for the purpose herein described,' a valve in which are combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air, the orifice being proportional to the strength of the spring, as directed."

And regarding the size of the stricture required, the Court say: —

"In the Richardson valve, all the steam, which escapes into the open air, escapes from the huddling chamber *through a stricture which is smaller than the aperture at the ground joint.*"

The italics are mine.

Richardson has very fully described the necessity for this arrangement and proportion of openings in the production of a safety valve to operate as described by him.

In the third paragraph of his patent of 1869, he describes the features of his improved safety valve patented in 1866, as follows: —

"My said invention (1869) relates to improvements in the invention described in Letters Patent granted to me, and bearing date the twenty-fifth day of September, 1866, which said patented invention relates to a means for providing a more free escape for the steam than could be obtained by safety valves as constructed prior thereto, and to insure the keeping of the valve open until the pressure of the steam in the boiler or generator falls below the pressure which was required to open it, the said means so patented consisting in forming the valve with a surface outside the ground joint for the escaping steam to act against, the said surface being surrounded by a projecting or overlapping lip, rim or flange, leaving a narrow space for the escape of steam when the valve is opened, but which, although of greater diameter than the valve seat, by reason of said lap presents a *less area of opening* for the escape of steam *than is produced at the valve seat*, so that the steam which escapes through the area between the valve [and seat?] shall exert pressure against the said surrounding surface, and thereby not only open the valve completely, but hold it up until the pressure of the steam in the boiler falls below the pressure by which the valve was opened."

The italics in this quotation are also mine.

At a later part of his specification, Richardson rehearses this necessity of making the stricture, through which the steam escapes

Int. 25. You were at one time supervising inspector-general of steam vessels of the United States. When was that?

Ans. I was connected with that service for more than twenty years; for about eighteen years supervising inspector of steam vessels, part of the time for New England and otherwise for the Pacific coast of the United States, and supervising inspector-general for about two years and a half, residence in Washington.

Int. 26. During your service as inspector-general, whether or not you made tests of safety valves under government direction. If so, when and where?

Ans. I did, in 1875, at the Washington Navy Yard. I tested about forty-five valves of different constructions. I refer to my testimony in this case, pages 256 to 260 of the record, as showing what these tests were and the results obtained.

Int. 27. Were these tests and their results published by the United States government?

Ans. They were, in September, 1875.

Int. 28. Who supervised the compiling and the making of the report of those tests?

Ans. I was chairman of the committee who made the report, and directed its arrangement.

Int. 29. At the time of its publication, had you retired from the service?

Ans. Yes, sir; I had. The report was made to the Board in 1876 while I was president, and was printed afterwards in 1877 by the new Board.

Int. 30. Please examine the printed pamphlet now handed you, and state whether or not that is the report referred to in your last answer.

Ans. This is a copy of the report.

[*Report shown witness is marked for identification "Government Safety Valve Test, J. G. S., Master."*]

Int. 31. Will a safety valve made in accordance with the mechanical description of the Richardson valve, as given by the Supreme Court in its opinion in this cause, operate within limits of loss such as, in your judgment and experience with safety valves, you would deem prudent?

[*Objected to, for reasons formerly given and as manifestly improper. Reserved as before.*]

Ans. It would not.

Int. 32. What, in your judgment and knowledge of the use of safety valves, would be a prudent limit of loss?

Ans. Three to five pounds pressure in a hundred.

Int. 33. Do what are called pop safety valves generally work within such limits?

Ans. Yes, sir, according to my observation.

Int. 34. Assuming that a safety valve, made like the Richardson valve, according to the mechanical description of the Court of it, should lose from twenty to thirty pounds in a hundred, while it might operate so that the steam pressure never would rise above that at which it is set, would such a value have any worth or value as a safety valve for ordinary use on steam boilers?

Ans. No, sir.

Int. 35. Will you please give your reasons for your opinion just expressed?

Ans. Because, in the reduction of twenty or thirty per cent in the steam by blowing off, the power of the boiler would be destroyed just to that extent for the time being, and this pressure would have to be recovered by the expenditure of a large amount of fuel and loss of time and labor before the boiler could be brought back into its normal working condition, while such a reduction of pressure might unfit the boiler for the time to perform the duty usually required of it, and so suspend its operation as a motor.

Int. 36. However effective a safety valve, such as is mentioned in Int. 34, may be to prevent the rise or accumulation of steam above the pressure at which it is set, has such a valve, if in its operation great loss of steam follows, a value as a safety appliance in the commercial world?

Ans. None whatever.

Mr. Henry B. Renwick, a witness for defendants, also testified about these valves. His testimony is as follows (Record, page 279): —

Boston, Jan. 26, 1887.

Int. 1. Please state your name, age, residence and occupation.

Ans. Henry B. Renwick; sixty-nine; reside in the city of New York, and am by profession a civil and mechanical engineer.

Int. 2. State what has been your experience in mechanics, your familiarity with subjects of invention as an investigator, and particularly what has been your experience and study in respect to steam machinery, including steam boilers and safety appliances for the same.

Ans. I have been engaged in mechanical pursuits since I left college, and for the last forty years have been familiar with subjects of invention and matters relating to patents, having had during that time, while principal examiner in the Patent Office, charge of all applications for steam engines, boilers, safety valves, etc., and was obliged then to investigate all that had been done in the art. I commenced the study of the steam engine when I was fourteen years old, and have kept it up since; have designed and superintended the construction of large steam engines, and was for about twelve

years United States inspector of boilers for the port of New York, during which time I had to examine boilers and safety valves almost daily.

Int. 3. What do you understand to be the constructon of the Richardson valve as set forth by the Supreme Court in its opinion, referring also to the directions as to the comparative area of the "stricture" opening with the area of the opening at the ground joint, as set forth in the 1869 Richardson patent, as applicable to the structure described in the Richardson 1866 patent.

[*Objected to because this witness was not called, and did not testify in the principal case, and because no construction of the construction of the Supreme Court of the Richardson patent by this witness is admissible, and because the question is otherwise incompetent on the accounting.*]

Ans. I have read the opinion of the Supreme Court, the Richardson patent of 1866, and the Richardson patent of 1869, and I understand from these that the Richardson valve of the 1866 patent is to be made with about the proportions of safety valve proper, and supplementary lifting area above the same, shown in the drawings of said patent, and that the "stricture," which is the ultimate escape opening for the steam past the lip of the supplementary surface, is to be smaller in area than the area of opening at the ground joint, which is the opening between the safety valve proper and its seat, this latter peculiarity of construction being set forth, not only in the opinion of the Court, but also in the Richardson patent of 1869.

Int. 4. If a value be made according to the Richardson drawings of 1866, and the directions of that patent, would it, or would it not, in your opinion, be an economical valve, and give your reasons for any opinion you may express?

Ans. In my opinion, it would not, because the area of the "stricture" is too small in proportion to the area at the ground joint under such a proportion of safety valve proper and supplementary area as is shown in the drawings of that patent. I have examined the measurements of the various parts of that valve, made by both the plaintiffs' and defendants' experts in the original case, and they agree substantially. The supplementary area and these two areas are nearly equal, while the area at the "stricture" is stated in the patent of 1869 and the opinion of the Supreme Court to be smaller than the area at the opening of the ground joint. Consequently, the pressure under the supplementary area after the valve has been lifted from its seat will be large, say, in round numbers, fifty or sixty pounds, more or less, as I have never made any experiments when the pressure or the main valve was one hundred. At any rate, it must be a pressure bearing a comparatively large proportion to the boiler pressure which is acting on the main valve, and consequently, the valve cannot be shut while this pressure is acting both upon the main and sup-

plementary valves until the boiler pressure has been considerably reduced. In this construction of valve, with the "stricture" smaller than the ground joint opening, the whole orifice through which the steam escapes, that is, through the ground joint opening, thence into the "huddling" chamber, as it has been called, and thence through the "stricture," will be somewhat like the escape of steam through a tube open at one end, and smaller in area there than throughout the other part of the tube, exerting pressure on all parts of the tube, including the valve proper, and requiring the whole pressure thus exerted to be overcome by the spring before the valve can shut. If the "stricture" were larger in area than the ground joint, then the escape passage would be somewhat like a tube with the escape orifice larger than the diameter of the tube; consequently, the pressure on the wall of the tube near the opening would be much less than at the narrowest point of the tube, and the spring would be sooner able to overcome the total pressure and shut the valve quickly.

Int. 5. In a table on page 491 of the evidence in this proceeding on accounting, there appear statements concerning certain safety valves there designated and previously described, showing their operation under steam, the dimension of certain parts of them, and the ratio of openings at the ground joint and outlet or "stricture" or each of them. Now, assuming these statements to be correct, are said safety valves made in accordance with the description of the valve in the Richardson patent of 1866, as the same is interpreted by Richardson in his patent of 1869, and as construed by the Supreme Court as you understand the same?

Ans. I have examined the table referred to in the question, and it shows that in all the valves there tried the area of opening at the lip, which is the "stricture" and set forth in line fourteen of the table is much larger, — in round numbers, about double the area of opening at the ground joint, which latter areas are printed on line thirteen of the table.

These measurements show conclusively that the valves enumerated in the question are not made in accordance with the Richardson patent of 1866, as interpreted by his patent of 1869, and the opinion of the Supreme Court. Their operation under steam would also prove the same fact to me, because I find that the valves enumerated in this table all shut when the boiler pressure had diminished only a few pounds, and were consequently economical, the diminution of the boiler pressure during the time which the valve was open, and up to the time it closed or shut, averaging from two to six pounds.

THIRD ERROR.

The point of this error is, that the Court adopted the view and procedure of the master, in stating the account of profits which accrued to the appellants for the period between Feb. 15, 1879, and Sept. 25, 1883 (the latter date being the expiration of the Richardson 1866 patent), in attributing the entire commercial value of the valves manufactured and sold by them to the improvement covered by the Richardson patent of 1866, and compelling them to account for the entire profit derived from the valves manufactured and sold by them during that period; whereas it ought to have determined that the appellees were entitled to only such profits as they could show were due to the use of the improvement set forth in the said Richardson patent over and above what would have been derived from the manufacture and sale of safety valves previously known to the art.

In the proceedings before the master, the appellees claimed the entire profit which had accrued to the appellants. In order to maintain this claim, it was necessary that it should be made affirmatively to appear that the Richardson invention was absolutely indispensable to a successful safety valve, or, to put it in the words of master, "Eliminate this invention from the defendants' valves, and they would be commercially worthless." The appellees assumed that this Court had settled this question, and the master fell into the same error. Our contention is that this Court has only found that the Richardson patent set forth an improvement which was distinguishable from what was shown in the prior safety valves having exactly the same elements in combination, in the circumstance that there was introduced into the Richardson valve a "huddling chamber," or a chamber constituting a supplementary steam chamber into which steam was admitted more freely than it could escape from it; or, otherwise stated, the area of the passage to this chamber for the entrance of the steam was greater than the area of the passage from it for its exit. The question to be passed upon by a master is not the question that has been already passed upon by a Court referring the case to him. The especial thing for a master to find is, what is the pecuniary value which has accrued to the defendants from the

use of the patented improvement. It is not for a master to say that the defendants shall account for all the profits which they have made, on the theory that the complainants' construction stands absolutely at the head of the art to which it relates, unless it has been made to appear before him in proof that the complainants' invention which has been appropriated by the defendants is absolutely indispensable to a successful structure, so that its elimination would make the defendants' apparatus worthless.

There has not been one line of proof submitted by the appellees before the master which will go to show the measure, pecuniarily speaking, of the Richardson improvement. For all that appears to the contrary, the Richardson valve accomplishes no greater saving than the ordinary steam safety valve in universal use since James Watts' time. The master has assumed, without right and without warrant, that the appellants were bound to account for their entire profits, and has refused to compel the appellees to make out before him in proof the money value of the Richardson device. He seemed to have forgotten the function which pertained to him as master, which was simply to ascertain the money value of the improvement which had been appropriated by the appellants.

The master's finding upon this matter is in these words (Rec., pages 14, 15) : —

"I attribute the entire commercial value of the valves manufactured and sold by the defendants, to the improvement covered by Richardson's patent of 1866."

He says further, in the same connection : —

"Richardson's invention, as described and claimed in that patent, revolutionized the art of relieving steam boilers from steam pressure rapidly approaching the dangerous point. It made effective for that purpose, — rapidly and with comparatively small loss of steam, — apparatus described in other patents, which very nearly embodied Richardson's invention, but did not actually contain it."

Pray, where did the master get his knowledge, when no evidence upon the matter was submitted before him by the appellees? We will assume that this Court used precisely this language in deciding the case on the merits. This furnished no excuse to the master for

refusing to receive, or to give weight to, evidence showing that *in fact the Richardson improvement not only never did revolutionize the art of steam safety valves, but was never employed by any manufacturer of steam safety valves before it was employed by the appellants.* The attention of the master was called to the fact that in the record on the merits before this Court, the construction which was given to the Richardson patent finally by it was never contended for by the appellees in making the record of the case, and there was never an issue made upon it by the appellants. The appellees put in, in making the record for the trial of the case on the merits, their patent, and exhibited a safety valve which was assumed to be constructed according to the patent. In fact, there was a misconception, in the preparation of the record, of the point which finally became so material in the estimation of this Court, in determining the characteristic of the Richardson patent.

The appellees proceeded upon the ground that Richardson was the first person to make a commercially valuable valve. The appellants took the ground that valves were previously known to the art which contained the same elements in combination, and that all that the appellees had done was to vary the proportions of the parts to each other, and that such act did not involve invention. It was upon this theory that the case was prepared for trial and was argued. This Court, however, when it came to read the 1869 Richardson patent, wherein the patentee professes to give a description of the structure shown in his previous 1866 patent, adopted the language used by him in respect to the characteristic of a huddling chamber, as if it had been found in the 1866 patent, and considered that the invention was distinguishable from what had gone before in the art in the circumstance that the huddling chamber had a greater area of passage for the entrance of the steam into the supplementary chamber than the area of the passage for its exit to the outer air. The Court did not find that the appellees' valves, professing to contain the Richardson structure, did in fact embody that structure. The point was not an issue in the case at all.

Now it followed that when the case came to the master, he was bound to look into the record in order to correctly shape his rulings

as to the theory upon which the account was to be obtained; and here the matter before him necessarily was the ascertainment, in a safety valve, of the pecuniary value in its economic effects, whether we regard the saving in the manufacture of the valve or the saving resulting from its use, and having ascertained this to assess the liability of the defendants.

The appellants did submit, from the following witnesses, the testimony as to what would be the commercial value of a valve made with the Richardson improvement. The appellees could furnish no evidence on this subject from their own products, because, as already stated, they had never employed the improvement in any single valve they had ever made. The testimony submitted upon this subject by the appellants is as follows: —

Testimony of Messrs. Hoadley and Harrison.

Mr. J. C. Hoadley, a witness for the defendants in the principal case, in the proceedings before the master, examined the Richardson Letters Patent of 1866, and obtained therefrom the dimensions of the safety valve therein described and shown; and thereupon he caused to be made two safety valves, one like the photolithograph drawing such as the Patent Office issued to the public, and the other following a certified copy of the original drawing sent by Richardson with his application for his patent, and upon which he obtained it. Of these and their trial, he testified as follows (Rec., page 213): —

Mr. Hoadley.

Int. 1. Please examine defendants' Exhibit Richardson Valve like photolithograph drawing, and state whether or not you have measured the parts thereof and tested its action under steam; if so, please give their dimensions and the result of your observations in testing the said exhibit.

Ans. On the eighteenth day of March, A. D. 1885, I carefully measured and verified all the essential dimensions of defendants' Exhibit Richardson Valve, like photolithograph drawing, — a safety valve made according to the proportions said to be set forth in patent No. 58,294, dated Sept. 25, 1866, granted to George W. Richardson, as the same are set forth in actual dimensions and ratios in the testimony of Charles W. Forbes, an expert witness called by complainants, to be found on pages 332, 333 of record (1) [in the principal case] as follows: —

(1)	Diameter of steamway	1.34 in.
(2)	Diameter of valve inside the lip forming the stricture	1.96 in.
(14)	Overlap of lip *c* of the valve below upper outer edge of valve seat E	.025 in.
(15)	Proportion this overlap, as represented in drawings, bears to width for passage of steam between inner edge of lip *c* and outer cylindrical surface of valve seat E	5 to 2
(16)	Average circumference of space between extended valve head and edge of lip *c*	6.126 in.
From the above circumference (16), we obtain the corresponding diameter, viz.		1.95 in.

(1) Record, No. 127, Oct. Term, 1884, pages 247, 248.

This diameter is .01 in. less than the diameter of the valve inside of the lip forming the stricture, and this difference of .01 in. between the diameters gives the width of the stricture. The foregoing dimensions agree with my own measurements of the same parts from a photolithograph reproduction of Richardson's drawing, forming part of a certified copy of Richardson's patent of 1866, from the Patent Office.

I have also found the dimensions of the respective parts of said safety valve which I measured and verified on March 18, 1885, to agree severally with Mr. Forbes's dimensions above given.

On Wednesday, March 18, 1885, between the hours of 3 and 6 o'clock P. M., I made thirteen experiments with the safety valve above described, namely, six experiments with an "ordinary spring," noted as such, four experiments with a "weak spring," noted as such, and three experiments with a "strong spring," noted as such.

The essential description and the results of these experiments are arranged in the following table: —

TABLE I.

No. of Experiment.	Kind of Spring.	Compression of Spring.	Pop. at lbs. per sq. in.	Close at lbs. per sq. in.	Reduction lbs. per sq. in.	REDUCTION. PER CENT. Single.	Mean.	Grand mean per cent.
1	2	3	4	5	6	7	8	9
1	Ordinary	0.31″	96	69	27	28.1	27.6	
2	"	0.31″	95.5	69.5	26	27.2		
3	"	0.40″	118.5	83	35.5	30	29.3	
4	"	0.40″	119	85	34	28.5		
5	"	0.27″	82	60	22	26.8	26.8	27.9%
6	"	0.27″	82	60	22	26.8		
7	Weak	0.35″	81.5	59	22.5	27.6	27.6	
8	"	0.35″	81.5	59	22.5	27.6		
9	"	0.29″	70	50.5	19.5	27.9	27.9	27.8%
10	"	0.29″	70	50.5	19.5	27.9		
11	Strong	0.30″	143	103	40	28		
12	"	0.30″	142	103	39	27.5	27.6	27.6%
13	"	0.30″	141	102.5	38.5	27.3		
						Mean of all,		27.8%

Int. 3. Please examine defendants' Exhibit Richardson Valve from original drawing, 1866, and state whether or not you have measured its parts and compared them with the corresponding parts as shown in the certified copy of the original drawing of a safety valve in Richardson's patent of 1866, introduced into this case. If so, please give your measurements, and state the results of any tests which you may have made with said exhibit to determine its practical operation.

Ans. On Dec. 21, 1885, I measured a safety valve which is the exhibit inquired of, made exactly according to dimensions previously measured by me from a tracing forming part of a certified copy of Richardson's patent of 1866, as follows: —

(1)	Diameter of steamway		2.25 in.
(2)	Diameter of valve inside the lip forming the stricture		3.260 in.
(14)	Overlap of lip *c* of the valve below upper outer edge of valve seat E . . .		0.030 in.
(15)	Proportion this overlap as represented in this drawing bears to width for passage of steam between inner edge of lip *c* and outer cylindrical surface of valve seat E,	ratio	5 to 2.7
(16)	Average circumference of stricture, in middle of its width		10.1913 in.
	Horizontal area of stricture circumference and width	sq. in.	0.16306
	Diameter of upper outer cylindrical surface of extended valve seat. . . .		3.228 in.
	Widths of stricture equal to one half the difference between inside diameter of lip *c* and outside diameter of extended valve seat E, $\frac{3.260-3.228}{2}=0.016$ . . .		0.016 in.

or, expressed in common fractions, $\frac{1}{64}$ in.

The safety valve above described was fitted with a lever and spring as set forth in Richardson's said patent. The length of the short arm of the lever was about 2.75 inches, the length of the long arm about 24.75 inches, both measured from the fulcrum. The leverage was therefore 9 to 1.

The spring made from No. 7 wire was equivalent to 0.32 inch compression directly over the valve.

Six experiments were recorded, with this valve and spring, Dec. 21, 1885, all with the same result. These experiments I designate as No. 55, No. 56 and No. 57.

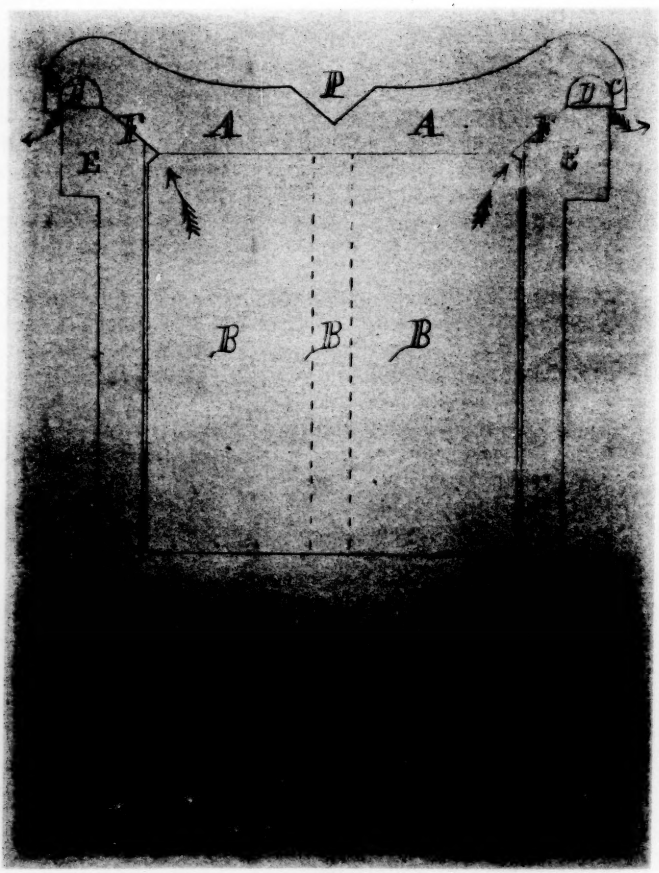
Experiments No. 55, 56, 57, Dec. 1, 1885; Richardson patent of 1866; 225 inches steamway, exactly according to patent drawing:

Warn at 97 lbs. Pop at 100 lbs. Close at 68 lbs. Reduction 32 lbs. = 32 per cent.

On Dec. 22, 1885, I again tried this valve, with another and a stronger spring made of No. 6 wire, equivalent to 0.215 in. compression directly over the valve. These tests I call experiments Nos. 58, 59, 60.

DEC. 22, 1885.

	No. 58.	No. 59.	No. 60.
Warn at		97	96
Pop at	100½	99	100
Close at	71	70	71
Reduction, lbs.	29½	29	29
Reduction, per cent	29.3	29.3	29.0


P
A
A
B
B
B

Mr. WILLIAM H. HARRISON, an accomplished mechanical engineer of large practical experience (Record, p. 228), in behalf of the defendants, also obtained the dimensions of the safety valves made by Mr. Hoadley, and compared them with the drawings from which they were made, and subjected them to trial. His testimony is as follows (Record, p. 228):—

Int. 3. Please state whether or not you understand defendants' Exhibit Richardson Valve, like photolithograph drawing. If so, have you obtained the dimensions of its parts as those of the valve proper and body, and how do these dimensions compare with the dimensions of the same exhibit as found in Ans. 1 of deposition of J. C. Hoadley herein? [*Supra*, p. 46.]

Ans. I do understand the exhibit, and have obtained its dimensions. The dimensions are the same as those given in Mr. Hoadley's answer.

Int. 4. Please examine Exhibit Richardson 1866 Patent, and state whether you have measured the parts of the safety valve shown in Figs. 3 and 4 of the drawing therein; and, if so, how do those dimensions compare with the dimensions of the corresponding parts of the said valve just referred to?

Ans. I have examined the patent and have measured the photolithographic reduction, and find the dimensions the same as those of the valve exhibited.

Int. 5. Whether or not you have made any tests of said valves with direct springs under steam pressure; and if so, please describe them.

[*Objected to as incompetent and irrelevant on the issues in this accounting as distinguished from the issues already passed upon by the Supreme Court, and as inadmissible on the issues passed upon by the Supreme Court; and further objected to because defendants have themselves shown a variance between the photolithograph from which this valve purports to be made and the original drawing filed by Richardson, for which alone complainants are responsible.*]

MASTER. Mr. Millett, please state the purpose for which you ask this question; that is, state its competency and relevancy to the issue before me, as you view it.

Mr. MILLETT. The purpose the defendants have in offering this testimony is to show that the safety valve, made exactly like the photolithograph drawing above mentioned, when subjected to use upon a steam boiler is not a prudent safety appliance, and as such has no commercial value, and that safety valves made in accordance with the description and drawings in the Richardson patent have no market value as safety appliances; and the same applies to safety valves made in accordance with the certified tracing produced of the original drawing; and for the further purpose of showing that the application by the defendants [of the Richardson patent], in whatever way found by the Court, in the making of their safety valve was

of no advantage to them and no loss to the complainants; and for the further purpose of showing that the complainants themselves have never made safety valves like those described in the said Richardson patent and drawing, and so have never suffered loss or damage by any act of the defendants in the making and sale of the Crosby valves; and for the further purpose of showing generally that no merchantable article could be manufactured by the use of the means patented by Richardson.

Mr. CLARKE. The objection is, that the Supreme Court has decided that the Richardson patented invention is a prudent safety appliance and had a commercial value, and that it has been largely made and used, and defendants having been found infringers, may be indeed permitted to prove the quantum of advantage to them and loss to complainants, but cannot be permitted to prove that their wrong did the defendants no injury whatever.

MASTER. The question may be put. I will endeavor to deal with the evidence which may be given in response thereto in my draft and final reports in such manner as to save the rights of the parties hereto.

Ans. I have made steam trials with this valve with direct springs. On Monday, Nov. 16, 1885, I took the dimensions of this valve, which agree with similar dimensions taken by Mr. Hoadley, and I now put in one additional, namely, diameter at top of ground joint 1.65 in.

First. In my first experiment of this series I used the spring marked "80 to 100 lbs." It is composed of 8½ turns of steel, .21 in. square section. The length when open is 2.85 in.; compressed for 100 lbs. pressure is 2.35 in.; and the amount of compression is .50 in. This valve warned at 99 lbs. boiler pressure, popped at 100 lbs., closed at 71 lbs., a reduction of 29 lbs. This was four times repeated after the final spring adjustment was made. The lift of the valve was .055 in.

[*Adjourned.*]

DEC. 30, 1886.

Second. On Monday, Nov. 17, 1885, I made an experiment, using the same Richardson Valve, but with a heavier spring, marked "100 to 125 lbs." This spring is made of steel, .23 in. square. The diameter outside is 1.32 in. There are 8½ turns. The length of the spring before compression is 3.10 in. When compressed for working pressure, its length is 2.75 in. The compression then is .35 in. In this trial the valve popped at 101 lbs. and closed at 72 lbs., a reduction of 29 lbs. of the boiler pressure. The lift of the valve was .055 in.

Third. On Saturday, Oct. 23, 1886, I tried the same Richardson valve, using a spring, marked "125 to 140 lbs.," which is here exhibited. It is composed of 7¼ turns of steel, .23 in. square. The outside diameter of spring is 1.40 in.; the length before compres-

sion, 3.05 in.; length compressed to 100 lbs. working pressure, 2.88 in. The compression then is .20 in. The experiment gave a result three times repeated of warned at 97 lbs., popped at 100 lbs., and closed at 75½ lbs. The reduction of boiler pressure was 24½ lbs. per square inch. The lift of the valve was .05 in.

Int. 6. Please state whether or not you have made any trials with the same valve rigged up with a lever and springs. If so, please produce the lever and springs used, to be put in evidence, and describe them, and thereupon describe the trials which you made.

Ans. I produce the lever spoken of, and the other attachments used therewith.

[*Lever and attachments produced are marked "Defendants' Exhibit Lever and Attachments (Harrison) Richardson Photo. L. Valve, J. G. S., Master."*]

I produce also the springs used in those tests.

[*Springs produced are marked "Defendants' Exhibit Lever Spring, No. 11 Wire, 80 to 100 lbs., Richardson Photo. L. Valve, J. G. S., Master"; "Defendants' Exhibit Lever Spring, No. 10 Wire, 100 to 120 lbs. Richardson Photo. L. Valve, J. G. S. Master"; and "Defendants' Exhibit Lever Spring, No. 9 Wire, 120 to 140 lbs., Richardson Photo. L. Valve, J. G. S. Master."*]

The length of the lever from fulcrum to centre of hook is 14 in.; from fulcrum to vertical axis of valve is 1.75 in.; the lever ratio then is 8 to 1. As used, the first spring was made of No. 11 steel wire, tempered, wound on a ⅞-in. mandrel; number of turns of wire, 32; length of body of spring when not strained, 3.70 in.; the outside diameter of the spring, 1.02 in.; and being defendants' Exhibit Lever Spring, No. 11 Wire, etc. The second spring used was made of No. 10 steel wire, tempered, wound on a ⅞-in. mandrel; number of turns of wire, 30; length of body of spring when not strained, 4.10 in.; the outside diameter of the spring, 1.07 in.; and being defendants' Exhibit Lever Spring, No. 10 Wire, etc. The third spring used was made of No. 9 steel wire, tempered, wound on a ⅞-in. mandrel; number of turns of wire, 26; length of body of spring when not strained, 4 in.; the outside diameter of the spring, 1.12 in.; and being defendants' Exhibit Lever Spring, No. 9 Wire, etc.

The trials which I made are as follows: —

MR. HARRISON'S EXPERIMENTS WITH RICHARDSON 1866 PHOTOLITH. LEVER AND SPRING.

Size of Spring used.	INCHES. Overlap Constant.	Extension of Spring.	Lift of Valve.	Warn.	STEAM PRESSURES IN POUNDS PER SQUARE INCH. Pop.	Close.	Reduction.
No. 11 wire	.025	2.00	.055	97	100	69	31
No. 11 "	"	2.00	.055	97	100	69	31
No. 11 "	"	1.71	.055	78	80	56	24
No. 10 "	"	1.40	.05	98	100	72½	27½
No. 10 "	"	1.70	.05	118	120	86	34
No. 9 "	"	.70	.043	98	100½	79½	21
No. 9 "	"	.85	.043	119	120	93½	26½
No. 9 "	"	1.00	.043	139	140½	104½	36

Int. 7. Please state whether or not you have made measurements of the valve shown in the certified copy of the original drawing of the Richardson 1866 patent; also measurements of corresponding parts of the safety valve marked "Defendants' Exhibit Richardson Valve from Original Drawing." If so, please state how they compare with each other, and also how they compare with the dimensions given in the deposition of J. C. Hoadley herein in answer to Int. 3.

Ans. I have measured the patent drawing, and I have measured the valve exhibited, and I find all the important dimensions the same. My dimensions are the same as Mr. Hoadley's. There was one dimension which he omitted, namely, the diameter at the top of the ground joint, which is 2.73 inches.

Int. 8. Whether or not you made any trials of the safety valve mentioned in the preceding question. If so, please describe them, stating what spring or springs you used at such trials.

Ans. Two springs were used, the same Mr. Hoadley mentions, one of No. 6 and one of No. 7 wire. The No. 7 steel-wire spring was wound on a 1-inch diameter mandrel; number of turns, 30. The length of this spring when closed after test, and without strain upon it, was 7 in.; when extended for 100 lbs. working pressure the length was $9\frac{9}{16}$ in.: the extension under strain then was $2\frac{9}{16}$ in. The other spring was made of No. 6 steel wire, tempered, wound on a mandrel $1\frac{1}{8}$ in. diameter. The length of this spring before straining was $6\frac{3}{16}$ in.; when strained for 100 lbs. working pressure, $8\frac{1}{2}$ in.; extension under strain, $1\frac{5}{16}$ in.; number of turns, 24.

On Monday and Tuesday, Dec. 21 and 22, 1885, in company with Mr. John C. Hoadley, I made the following experiments with this valve, using these springs described, with the following results as tabulated: —

		STEAM PRESSURES IN POUNDS PER SQUARE INCH.			
Size of Spring.	Inches Lift.	Warn.	Pop.	Close.	Reduction.
No. 7	.059	97	100	68	32
"	"	97	100	68	32
"	"	95	100	68	32
No. 6	.0555	97	100.5	71	29.5
"	"	97	99	70	29
"	"	96	100	71	29

It will be observed that at the trials of these Richardson valves, the loss of steam during the time of their action was nearly one third of the pressure at which they opened; that is, from twenty-one to thirty-six pounds loss by the smaller valve when it opened at one hundred pounds, and from twenty-nine to thirty-two pounds loss

by the larger valve, opening at one hundred pounds; while the areas of the openings at the ground joint and lip were in the ratios of 1 to .91 and 1 to .86 respectively, being larger at the ground joint, just as Richardson has stated (Harrison, *supra*, p. 28).

Now, of valves whose operations were like these, and of all valves made from Richardson's patent, Mr. Renwick has testified that they are not and would not be economical valves (Renwick, *supra*, p. 39).

Gen. Burnett (*supra*, Ints. 31, 32, 33, 34, 35 and 36, p. 38) says that a safety valve which "*should lose from twenty to thirty pounds in a hundred*," while it might operate so that the steam pressure never would rise above that at which it is set," would have "*no worth or value as a safety valve for ordinary use on steam boilers.*"

To break the overwhelming force of this exhibition of the valve of the Richardson patent, the complainants introduced the testimony of Mr. Charles W. Forbes, their witness in the principal case, and the same person alluded to by Mr. Hoadley as furnishing the dimensions of the valve shown in the drawing issued with the Richardson patent, and verified by him, and from which he made one of the valves testified of by him and by Mr. Harrison.

Mr. Forbes (Rec., p. 284, *et seq.*) assailed the valves as not conforming to the patent, and attempted to show a variation. Yet notwithstanding his efforts with supposed templates of valves and drawings, he was unable to do so. His own templates did not conform to all the characteristics of the drawings (Rec., p. 301, *et seq.*).

Even unfriendly templates justified the appellants' work (Harrison Record, p. 317, Int. 185, *et seq.*).

As a further means of impeaching the valves introduced by the appellants, he caused to be made valves purporting to follow the patent. These he testified were good valves in action.

He could give no dimensions of them, nor any data of their trial, except that they worked well, nor did he even try to verify the dimensions of appellants' exhibits, except by the coarse and uncertain method of a comparison by calipers (Rec., pp. 297, 302–306).

And notwithstanding in the principal case he had testified that the stricture or exit opening from the supplementary chamber was

one one-hundredth inch in width, as appeared in the photolithograph drawing, he now claimed that for a valve of that diminutive size the width of the stricture should be one sixty-fourth inch, and he so made it, the only dimensions he could give (Rec., Int. 25, p. 292).

These valves were submitted to Messrs. Burnett and Harrison for examination and trial.

Mr. HARRISON thus testifies, (Rec., p. 314): —

Int. 173. You are the same William H. Harrison who has before testified in this case, pages 315 to 360, are you not?

Ans. I am.

Int. 174. Have you examined and do you understand complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866, and have you obtained the dimensions thereof?

Ans. I have examined and do understand said exhibit, and have obtained the dimensions thereof.

Int. 175. Please give those dimensions, and also the corresponding dimensions which you have obtained heretofore of the safety valve shown in the original drawing of the Richardson patent of 1866; and, if the same are tabulated, please produce the table as a part of your answer.

Ans. I have tabulated the same and produce the following table, showing the dimensions called for: —

	Dimensions in Inches. Diameters.					
	Steamway.	Top of Ground Joint.	Extended Valve Seat.	Inside of Lip.	Horizontal Width of Outlet.	Overlap.
Dimensions of tracing forming part of Certified Copy of Richardson's patent of 1866. Hoadley's Testimony, p. 301; Harrison, p. 319 of Accounting Record.	2.25	2.73	3.228	3.26	1/64 or .016	.03
"Complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866."	2.25	2.74	3.210	3.268	.029	.02

Int. 176. Have you made any tests of the said complainants' exhibit, and examined and measured the springs used by you in those tests? If so, please describe said springs, and give their measurements.

Ans. I have made tests of the valve, and have measured the springs which I used in those tests. There were five of them, which are here exhibited.

1. The lever attachment of the defendants' Exhibit Richardson Valve from Original Drawing, and described by Mr. Hoadley at the foot of page 301, and the spring of No. 6 wire described by me, page 320, and marked "Spring for Richardson Valve, of No. 6 Wire." The extension of this spring, when strained for 100 lbs. popping pressure, was $1\frac{15}{16}$ inches.

2. The same lever as in previous experiment, using the defendants' No. 7 spring described by me on record, page 320, and marked "Spring for Richardson Valve, of No. 7 Wire."

3. The direct spring of the complainants here exhibited, and marked with four notches. This spring is composed of $6\frac{1}{2}$ turns of steel, $\frac{3}{8}$ inch square; the outside diameter is $2\frac{1}{16}$ inches; length when free, 4.06 inches; when compressed for 100 lbs. the length is 3.80 inches; the compression then is .16 inch.

4. The direct spring of the complainants, marked with five notches. This spring is composed of $6\frac{1}{2}$ turns of steel, $\frac{3}{8}$ inch square; the outside diameter is $2\frac{3}{16}$ inches; length when free, 4.12 inches; length when compressed for 100 lbs., 3.88 inches; compression, .27 inch.

5. The direct spring of the complainants, marked with six notches, composed of $6\frac{1}{2}$ turns of steel, $\frac{7}{32}$ inch square; outside diameter, $2\frac{1}{8}$ inches; length when free, 4.06 inches; length when compressed for 100 lbs., 3.68 inches; compression is .38 inch.

Int. 177. Have you examined, and do you understand, complainants' Exhibit Forbes Exhibit Corrected Representation Richardson Valve from Photolitograph Drawing, and have you measured same?

Ans. I have examined and measured said exhibit.

Int. 178. Please give the dimensions obtained by you in such measurement, and the corresponding dimensions as found by you in your measurement of the drawings of the printed copy of the Richardson patent of 1866, and those also obtained by Charles W. Forbes of the same drawings, as found in the record in the principal case, on pages 332 and 333(1).

Ans. These dimensions I have tabulated, and I now produce the table as my answer, as follows: —

	Dimensions in Inches. Diameters.					
	Steamway.	Top of Ground Joint.	Extended Valve Seat.	Inside of Lip.	Horizontal Width of Outlet.	Overlap.
Photolithographic drawing of Patent, granted to Geo. W. Richardson, Sept. 25, 1866. (Forbes' testimony, pages 332 and 333, record in principal case.(1) Hoadley, pages 298 and 299. Harrison, page 316 of accounting record.)	1.34	1.65	1.94	1.96	.01	.025
Forbes' Exhibit Corrected Representation from Photolithographic Drawing.	1.34	1.65	1.94	1.968	.014	.009

(1) Record, No. 127, Oct. Term, 1884, pages 247, 248.

Int. 179. As said Forbes has not given the width of the stricture directly, will you please state what the width is as ascertained from the dimensions spoken of as his in the previous question?

Ans. .01 inch. I find on page 333(1) of principal record, a dimension given as "Average circumference of space between extended valve head and edge of lip *c*, inches, 6.126." The diameter of this circumference is 1.95 inches. I also find, page 332(1), the statement, "Diameter valve inside the lip forming the stricture, inches, 1.96." Now, if the average diameter is 1.95 inches, and the greater diameter is 1.96 inches, the less diameter, which is the diameter of the extended valve seat, must be 1.94 inches, and the difference between 1.94 inches and 1.96 inches is .02 inch, and one half of this difference is the horizontal width of the outlet or stricture, and is .01 inch.

Int. 180. Have you made any tests of said complainants' exhibit, and if so, have you examined and measured the springs used by you in your tests? If so, give your measurements.

Ans. I have tested said exhibit, using five different direct springs, which are here exhibited.

1. The defendants' spring, marked "Richardson Spring 80 to 100 lbs., Weak Spring," the dimensions of which I gave on page 317. I find, however, that, since I testified, this spring has taken a permanent set, and the length when free is now 2.65 inches, and when compressed for 100 lbs. working pressure on this valve, the length is 2.35 inches, a compressure of .30 inch.

2. The spring marked "Richardson Spring 100 to 125 pounds, Ordinary Spring," the dimensions of which I gave on page 318. The compressure at working pressure of 100 pounds is .35 inch.

3. The spring marked "Richardson Spring 125 to 140 pounds, Strong Spring." The dimensions will be found on page 318 of this record. The compression at 100 pounds is .20 inch.

4. The spring marked "Forbes Strong Richardson Spring, Comp. .15 inch for 100 pounds." This spring is composed of $7\frac{1}{4}$ turns of steel, $\frac{1}{4}$ inch square. The outside diameter is $1\frac{5}{16}$ inches; length when free, 2.80 inches; length when compressed for 100 pounds, 2.70 inches; compression is therefore .10 inch.

5. The spring marked "Rich. Ordinary Spring, Comp. .25 inch for 100 pounds." This spring is composed of $8\frac{1}{2}$ turns of steel, $\frac{7}{32}$ inch square. The outside diameter is $1\frac{1}{8}$ inches; length when free, 3.28 inches; compressed for working pressure of 100 pounds, 3.03 inches. The compression is .25 inch.

Int. 181. Please give the results of your tests of the said complainants' exhibits testified of by you, showing the lift of valve when blowing under each spring used, the opening and closing point, and the amount of loss of steam in pounds pressure by such valve; also

(1) Record, No. 127, Oct. Term, 1884, pages 247, 248.

the areas of the openings in such valve when blowing, both at the ground joint and at the outlet of the lip, with the ratio of such openings.

Ans. I have tabulated the results of my experiments, and also the results of my calculations as to areas of openings, and I now present the table as my answer, as follows: —

"Forbes Exhibit Corrected Representation Richardson Valve from Photolithographic Drawing."

Springs.	Inches.		Areas of Openings in Square Inches.			Steam pressure in Boiler in Pounds per Square Inch.		
	Compression of Spring at 100.	Lift of Valve.	At ground joint	At outlet.	Ratio of ground joint to outlet.	Opened.	Closed.	Reduc.
"Forbes Strong Richardson Spring."	.10	.02	.0729	.1105	1 to 1.51	100	95½	4½
"Richardson Spring, 125 to 140 pounds, Strong."	.20	.025	.0909	.1305	1 to 1.44	100	95	5
"Richardson Spring, 100 to 125 pounds, Ordinary Spring."	.35	.03	.1089	.1547	1 to 1.42	100	95	5
"Richardson Ordinary Spring, Comp. .25 inch for 100 lbs."	.25	.04	.1448	.2087	1 to 1.44	100	95	5
"Richardson Spring, 80 to 100 pounds, Weak Spring."	.30	.05	.1804	.2658	1 to 1.47	100	93½	6½

"True Representation Richardson Valve from Original Drawing of 1866."

Springs.								
Complainants' Spring, mark 4 notches.	.16	.03	.1967	.3114	1 to 1.58	100	96	4
Defendants' Lever with Defendants' No. 6. Extension. $\frac{1}{8}$		.033	.2163	.3236	1 to 1.50	100	95	5
Complainants' Direct Spring, mark, 5 notches.	.27	.04	.2618	.3584	1 to 1.37	100	94½	5½
Defendants' Lever, with No. 7 Spring. Extension. $.2\frac{3}{16}$		.047	.3072	.4030	1 to 1.31	100	92	8
Complainants' Direct Spring, mark, 6 notches.	.38	.05	.3267	.4245	1 to 1.30	100	93	7

Int. 182. Where were these tests made, and who was present with you in making them?

Ans. These tests were made on the large testing boiler of the defendant company. There was present with me Mr. William Burnett.

Int. 183. Whether or not it was the same boiler used by you in your tests of the defendants' exhibits already testified of as made by you, and what was its condition as compared with its condition at those tests?

Ans. It was the same boiler, and the conditions were alike.

Int. 184. What was the action of the complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866?

Ans. When using the defendants' lever and springs No. 6 and 7, the action was good. When using the complainants' direct spring, marked with four notches, the lift of the valve was small, — only .03 inch, as shown in the table; the valve was also difficult to adjust to popping pressure on account of the uncertainty of its action. With the defendants' direct springs, marked with five notches and with six notches, the action was good.

GEN. BURNETT testified as follows (Rec., page 328): —

BOSTON, Oct. 3, 1887.

Int. 69. Please state your name, and if you have been previously examined in this case.

Ans. William Burnett; I have testified in this case, and my testimony is printed on pages 360 to 379.

Int. 70. Have you examined and do you understand complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866, and Forbes Exhibit Corrected Representation Richardson Valve from Photolithograph Drawing?

Ans. I have examined them, and understand them.

Int. 71. Have you made measurements of certain parts and openings of said exhibits, obtaining dimensions? If so, please compare with your minutes the dimensions given of the first of said exhibits by Harrison in his answer to Int. 175, Record, page 428; also his dimensions given in answer to Int. 178, Record, page 429, of the second of said exhibits.

Ans. I have examined them, and find them to correspond in measurements with my own minutes of the examination, made Aug. 30 and 31, 1887.

Int. 72. Have you made any tests of said exhibits with various springs? If so, where, and who was associated with you, if any one, in making such tests?

Ans. I made a number of such tests at the works of the Crosby Steam Gage and Valve Company, the thirty-first day of August, in company with Mr. Harrison. Five tests of each valve were made, with different controlling springs.

Int. 73. Please examine the table of tests, showing the tests of the two exhibits mentioned in Int. 70, the compression of the springs, the lift of the valves, the area of openings at ground joint and outlet, and the ratio of such openings of each of said exhibits, with the various springs used, as given by Mr. Harrison in his answer to Int. 181, Record, page 431, and state how they compare with your minutes made of such tests, and your computations made on their account.

Ans. I have examined the figures in the table, and compared

them with my notes taken at the time, and I had previously examined the table fully with Mr. Harrison, finding it correct.

Int. 74. Please compare complainants' Exhibit True Representation Richardson Valve from Original Drawing of 1866 with the safety valve described in the Richardson patent of 1866, particularly as to the dimensions of the stricture, and the overlap of the lip, and state whether or not such exhibit differs from said described safety valve, and, if so, wherein. You may assume the dimensions given on Record, page 301, by Mr. Hoadley, of the patent drawing, and by Mr. Harrison on page 319, to be the correct measurements of the Richardson drawing.

Ans. Assuming the dimensions given by Mr. Hoadley to be correct, I find a number of important deviations from those measurements in complainants' exhibit, referred to, as given by Mr. Forbes. These deviations are as follows: —

Hoadley.	Inches.	Forbes.	Inches.
Diameter of steamway,	2.25	Diameter of steamway,	2.25
Diameter of valve inside lip,	3.260	Diameter of valve inside lip,	3.268
Diameter extended valve seat,	3.228	Diameter extended valve seat,	3.21
Overlap of lip,	0.030	Overlap of lip,	0.02
Width of stricture,	0.016	Width of stricture,	0.029
Diameter top ground joint (supplied by Harrison),	.2.74	Diameter top ground joint,	2.74

This statement shows several important deviations in measurement, viz.: —

1. To the diameter of the valve inside the lip, Forbes adds .008 to the measurement found by Hoadley.

2. From the diameter of the extended valve seat, Forbes takes .018 from the measurement found by Hoadley.

3. This materially affects the horizontal width of the stricture; Hoadley found the width to be but .016, but Forbes makes it .029, or about 81 per cent greater than the width found by Hoadley.

4. Hoadley makes the overlap of the valve lip .03, while Forbes makes it but .02, or one third less than found by Hoadley.

Int. 75. What is the effect of such variations, mentioned by you, in making the openings at the ground joint and outlet from the chamber in said exhibit, when it is lifted in the act of blowing?

Ans. The valve will not rise so high from its seat, and it will not blow the steam down so much before closing.

Int. 76. In such case, how do the two openings substantially compare as to area?

Ans. The area of the ground joint in its relation to the area of the stricture at its periphery will be as 1 to 1.50.

Int. 77. Does the complainants' Exhibit True Representation of

Richardson Valve from Original Drawing of 1866, having outlets of the ratio stated, conform to the mechanical description of the safety valve described in the Richardson patent of 1866, as interpreted by the Supreme Court in this case? And you may refer, if you desire, to the Richardson patent of 1869, to illustrate your opinion.

Ans. It does not conform to the patent, inasmuch as the same requires that the opening produced at the periphery stricture shall always be less, when the valve is opened, than the opening produced at the ground joint.

It is no wonder that Mr. Forbes did not wish to know anything about his valves except what he observed at their trial. Any knowledge of their dimensions would at once have disclosed to him even their dissimilarity to Richardson's patent or the appellants' exhibits made according to this patent. The single exception of any positive statement by him of a dimension was wrong. He said the stricture of his valve made from the original drawing of 1866 was .016, or one sixty-fourth of an inch, while both the appellants' witnesses found it to be .029 of an inch, or about 81 per cent greater. The effect of this difference is well stated by Mr. Harrison to be such that the lift of the valve in action would be less, and the loss of steam therefore less. [*Supra*, Ints. 210 and 211.]

Both appellants' witnesses state positively that these Forbes valves were not made like the patent of 1866. Nor could they be, with such a wide departure from the exact dimensions shown in the drawings. The opening from the supplementary chamber of each of the valves was nearly or quite fifty per cent greater than that at the ground joint into it. They conformed more to the Webster type of valve than the described Richardson.

RULE OF ACCOUNTING.

It was the duty of the master to apply, in this case, the rule laid down in the cases considered below, and which rule is, that where a patented invention relates to an improvement on previously known devices for the same purpose, the complainants shall show what is

the profit and advantage which results specially from the use of such particular improvement; and if they refuse to furnish the data upon which the value of the improvement patented to them can be ascertained and measured, then there can be no recovery beyond nominal profits and damages in their favor.

This rule was established for the first time in equity in the case of

Mowry v. *Whitney*, 14 Wall. 620, 650.

Here the Court say: —

"The findings of the master justified no such decree. It must be conceded that the findings are incomplete, obscure, and in some particulars incongruous, but it is not a legitimate construction of them taken together, that the benefit which the defendant derived from the use of the complainants' invention was equal to the aggregate of profits he obtained from the manufacture and sale of the wheels as entireties, after they had been completed. It is as true of a process invented as an improvement in a manufacture, as it is of an improvement in a machine, that an infringer is not liable to the extent of his entire profits in the manufacture. If the wheels made by the defendant would have had no market value above that of cast iron if they had not been annealed and slow cooled, the same may be said if they had been cast without a chill. The same principle, therefore, which gives to the complainants the aggregate profits of the entire manufacture, would give the same profits to a patentee of the process of chilling, if there were one, and as there are many processes in the manufacture, for each of which it is conceivable there might be a patent, and as every one of the processes is necessary to make a marketable wheel, an infringer might be mulcted in several times the profits he had made from the whole manufacture. We cannot assent to such a rule. The question to be determined in this case is, what advantage did the defendant derive from using the complainant's invention over what he had in using other processes then open to the public and adequate to enable him to obtain an equally beneficial result. The fruits of that advantage are his profits. They are all the benefits he derived from the existence of the Whitney invention. It is found that there were other processes by which the inherent strain caused by unequal cooling could be, and was prevented, counteracting which strain was the sole object of the complainant's invention, and a car wheel could be prepared for similar service, valuable in the market, and salable at a price not less than was obtained for those which the defendant manufactured. The inquiry then is, what was the advantage in cost, in skill required, in convenience of operation, or marketability, in bringing car wheels by

Court could give, no matter how much the person had actually been injured, would be that the jury must return a verdict for nominal damages only. Here in this case there is not one particle of proof pointing out how much of the general profits the appellants have received on their whole business, including manufacturer's profits, is attributable to the subject of the invention of Richardson.

Garretson v. *Clark*, 111 U. S. 120, 121.

This was a suit in equity. The defendants were held to be infringers of the patent, and the case went to a master. Says the Court, after stating the case: —

"When a patent is for an improvement, and not for an entirely new machine or contrivance, the patentee must show in what particulars his improvement has added to the usefulness of the machine or contrivance."

Just as we say here, this is a patent for an improvement on old safety valves. That is what the opinion of this Court declares. It says that these old structures are the same as the Richardson valve with respect to their elements, but that this is distinguished from those, as we now ascertain in very clear terms, for the reason that the *strictured* huddling chamber is a particular characteristic which distinguishes that portion of the device from the corresponding devices in prior structures. The opinion continues: —

"He must separate its results distinctly from those of the other parts, so that the benefits derived from it may be distinctly seen and appreciated. The rule on this head is aptly stated by Mr. Justice Blatchford in the court below: 'The patentee,' he says, 'must in every case give evidence tending to separate or apportion the defendant's profits and the patentee's damages between the patented feature and the unpatented features, and such evidence must be reliable and tangible, and not conjectural or speculative; or he must show, by equally reliable and satisfactory evidence, that the profits and damages are to be calculated on the whole machine, for the reason that the entire value of the whole machine, as a marketable article, is properly and legally attributable to the patented feature.'

"The plaintiff complied with neither part of this rule. He produced no evidence to apportion the profits or damages between the improvement constituting the patented feature and the other features of the

mop. His evidence went only to show the cost of the whole mop, and the price at which it was sold. And of course it could not be pretended that the entire value of the mop-head was attributable to the feature patented."

The Richardson patent is only a claim for a combination of devices, limited on its face to an improvement in a prior art.

A very instructive case is

Dobson v. *Hartford Carpet Co.*, 114 U. S. 439, 444.

The opinion was delivered by Mr. *Justice* BLATCHFORD at the October term of the Supreme Court in 1884. It reviews all the prior cases on the subject of accounting.

It says: —

"This court has, in a series of decisions, laid down rules as to what are to be regarded as 'profits to be accounted for by the defendant,' and what as 'actual damages,' in suits for the infringement of patents; and no rule has been sanctioned which will allow, in the case of a patent for a design for ornamental figures created in the weaving of a carpet, or imprinted on it, the entire profit from the manufacture and sale of the carpet, as profits or damages, including all the profits from the carding, spinning, dyeing and weaving, thus regarding the entire profits as due to the figure or pattern, unless it is shown, by reliable evidence that the entire profit is due to the figure or pattern. It is a matter of common knowledge, that there is an infinite variety of patterns in carpets, and that, between two carpets, of equal cost to make and equal merit as to durability of fabric and fastness of color, each with a pattern pleasing to the taste, one having a design free to be used, and the other a design protected by a patent, the latter may or may not command in the market a price larger than the former. If it does, then the increased price may be fairly attributed to the design; and there is a solid basis of evidence for profits or damages. But, short of this, under the rules established by this Court, there is no such basis. The same principal is applicable as in patents for inventions. The burden is upon the plaintiff, and, if he fails to give the necessary evidence, but resorts, instead, to inference and conjecture and speculation, he must fail for want of proof. There is another suggestion, of great force. The carpet with the infringing design may be made on an infringing loom, and various infringing processes of mechanisms for carding, spinning or dyeing

may be used in making it, and, if the entire profit in making and selling it is necessarily to be attributed to the pattern, so it may as well, on principle, be attributed to each of the other infringements, and a defendant might be called on to respond many times over for the same amount. There is but one safe rule — to require the actual damages or profits to be established by trustworthy legal proof. It is not necessary to cite at length from the cases decided by this court on the subject. It is sufficient to refer to them."

These are, except those already considered, as follows: —

Livingston *v.* Woodworth, 15 How. 546.
Seymour *v.* McCormick, 16 How. 480.
Mayor of New York *v.* Ransom, 23 How. 487.
Philp *v.* Nock, 17 Wall. 460.
Littlefield *v* Perry, 21 Wall. 205.
Birdsall *v.* Coolidge, 93 U. S. 64.
Cawood Patent, 94 U. S. 695.
Blake *v.* Robertson, 94 U. S. 728.
Black v. Thorne, 111 U. S. 122.

To which may be added the later cases of

Dobson *v.* Dornan, 118 U. S. 10.
Tilghman *v.* Proctor, 125 U. S. 136.

FOURTH, FIFTH, SIXTH, SEVENTH AND EIGHTH ERRORS.

These several errors will be considered together, and the arguments in support of the appellants' contention in regard to the third error is equally applicable to the discussion of these.

The appellants submitted in evidence before the master the Kunkle valve, and they also directed the attention of the master to the decision of this court, rendered after the opinion in the present case, in *Consolidated Safety Valve Company* v. *Kunkle*, 119 U. S. 45, affirming the decision of the Circuit Court, reported in 14 Fed. Rep., 732. The appellants insisted before the master that this court, both in its opinion in this case and in its opinion in the Kunkle case, had established beyond question that the Richardson improvement con-

sisted in such a construction of the huddling chamber device, in comparison with the corresponding member of former safety valves, as involves the employment of a passage for the entrance of the steam into the supplementary chamber when the valve lifted, greater in area than the area of the exit passage from such chamber.

In the Kunkle case (14 Fed. Rep., 732, 737), Judge Blodgett in his consideration of the Richardson valve referring to the patent of 1869, to ascertain what the inventor understood to be the strictured orifice leading from the huddling chamber, said: —

"I am certainly unable to find in Kunkle's valve such a stricture as is specially described by Richardson in his patent of 1869. In the specifications of that patent he says: —

"'The said means so patented, (referring to his patent of 1866), consist in forming the valve with a surface outside of the ground joint, for the escaping steam to act against, the said surface being surrounded by a projecting lip, rim, or flange, leaving a narrow space for the escape of the steam when the valve is open, but which, although of greater diameter than the valve seat by reason of the said lip, presents a less area of opening for the escape of steam than is produced at the valve seat, so that the steam which escapes through the area between the valve shall exert pressure between the said surrounding surfaces, and thereby not only open the valve completely, but hold it up until the pressure of the steam in the boiler falls below the pressure by which the valve was opened.'

"This, as I understand it, is Richardson's definition of the construction and operation of his stricture, and requires in specific terms that the space for the escape of the steam between the flange and ring encircling the expanded valve head, shall be of less area than the area of escape at the valve seat; a peculiarity not provided for in Kunkle's valve, and evidently not intended to be a part of his mechanism, as from the time the steam passes through the ground joint of Kunkle valve, it is nowhere throttled and compelled to pass through a less area on its way to the open air, its exit passages increasing constantly in area, instead of diminishing.

"With strictures shown in the older stages of the art, I am therefore clearly of opinion that Richardson must be confined to his special mode of producing the stricture; and I am also of opinion that whatever of stricture the defendants show is more nearly, in the mechanical mode of producing it and in its operation, like the older devices of Beyer, Hartly, Webster, Greene, Waterman and Naylor."

Upon an appeal of this case this Court said: —

"The decree in the present case was made in January, 1883, and proceeded, as it states, on the ground that the defendant's valves did not infringe the patents. This also appears from the decision of the Circuit Court, reported in 14 Fed. Rep., 732. As the defendant's valves have no huddling chamber, and no strictured orifice leading from a huddling chamber to the open air, we are of opinion that they do not infringe either of the patents." *Consolidated Safety Valve Co.* v. *Kunkle*, page 66, *supra*.

With no less force this language applies to the design and characteristics of the valves of commerce made and sold by the appellees and considered herein *supra*, page 12, *et seq*.

The appellants also submitted proof before the master as to the construction of safety valves having an initial area, a supplementary area, and a chamber through which the steam passed when the valve was lifted, and which exerted a lifting pressure upon such valve in opening greater than the lifting pressure upon the valve when closed. A specimen of such valves was found in the English Letters Patent to Webster of 1857 (see Record in principal case, No. 127, Oct. Term, 1884, page 56, *et seq.*), and, among other things, the appellants proceeded to put in evidence valves of the Webster type, made exactly according to the drawings and specifications of the Webster patent(1), and not embodying the improvement described in the Richardson patent, as the same has been defined by this Court to be, and the appellants claimed that the master was bound, in view of this proof, to ascertain, as a fact, what was the value of the Richardson improvement in comparison with what previously was known to the art, and free to the appellants to make. This the master refused to do, but insisted on assessing all the profits against the appellants. The testimony bearing upon the introduction of the Webster valve, made exactly according to the patent, is given below, and such testimony was not controverted. There can be no question as to the accuracy of the Webster valve and its operations so put in evidence before the master, because two Webster valves so put in evidence

(1) These valves were made to dimensions as found in Figs. 1 and 3 of the drawings of the Webster patent. See reproduction of these figures on opposite page. See also testimony, *infra*, page 69, *et seq*.

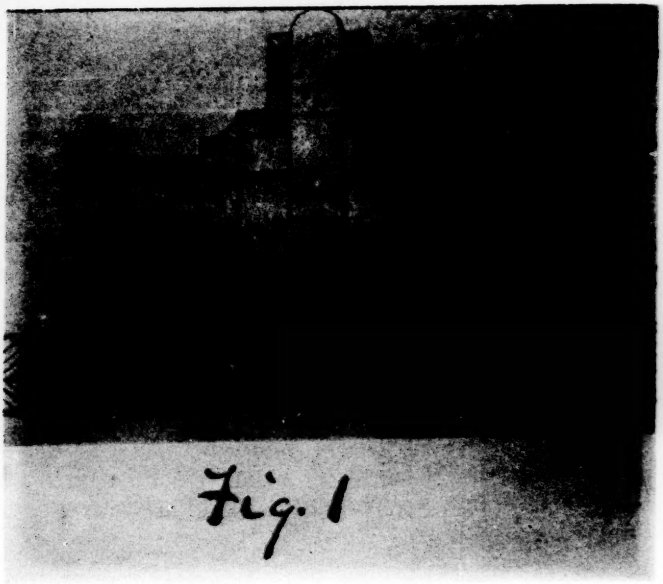


Fig. 1

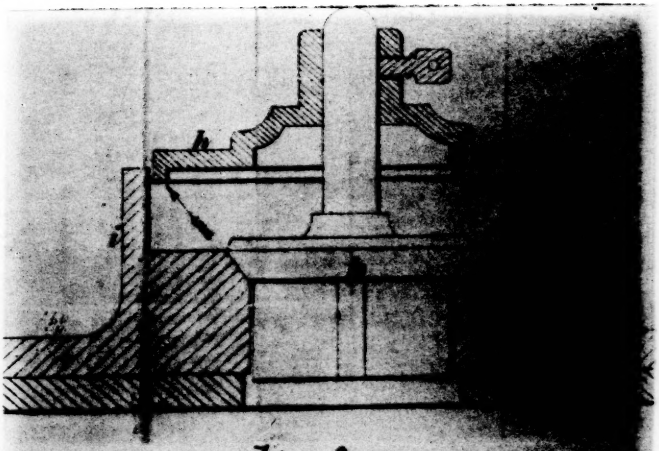


Fig. 3

Reproduction of drawings of [illegible]

FULL SIZE

were made by the appellees as exhibits in the case on the trial of the merits. (See Record, page 218, *et seq.*)

These were said to conform to the drawings Fig. 1 and Fig. 3 of the Webster patent of 1857. The only testimony as to those exhibits in the Record at the Rules was that of the appellees. (See Record, Nos. 127 and 128, October Term, 1884, page 260, *et seq.*) To determine the question of the practical economy and advantages of their valves in the accounting proceedings before the master, they were submitted by the appellants to two of their witnesses, Messrs. Hoadley and Harrison, who ascertained their dimensions and tested them.

There were also made by the appellants under the direction of these witnesses, two other Webster valves above mentioned, to conform more carefully to the dimensions of the Webster drawings and the directions of the patent than those made by the complainants.

All the Webster valves, those made by the complainants and those made by the defendants (appellants), were good economical operating valves, notwithstanding they conformed to the *exact dimensions* of a *patent drawing* used in this case as a *working drawing*. (Testimony, *infra*, pages 69, *et seq.*)

Of both the appellees' and appellants' Webster valves, Mr. Hoadley testified as follows (Record, page 218): —

TESTIMONY OF MR. HOADLEY.

Int. 5. Please examine complainants' Exhibit Webster Fig. 1 and Fig. 3, introduced in this case, and state whether or not you have measured the several parts thereof, and subjected the said exhibit to practical tests. If so, please give their dimensions, and the result of your trials.

Ans. On the fourteenth day of December, 1885, I made a number of experiments with an exhibit designated as complainants' Exhibit Webster Fig. 1 and Fig. 3, corresponding to Fig. 1 and Fig. 3 of Webster's patent of Great Britain, No. 1955 of 1857. They are given in Tables V. and VI.

The dimensions of this exhibit, as to its essential parts, are as follows: —

Diameter of steamway	1.184 in.
Diameter of upper edge of valve seat at bevelled ground joint	1,480 "
Diameter of rim surrounding valve seat at its upper edge, inside	2.41 "

Diameter of rim surrounding valve seat at its upper edge, outside	2.48 in.
Thickness of this rim at its upper edge	.035 "
Height of rim, inside, above plane of extended valve seat,	.50 "
Diameter of lip around adjustable flange, Fig. 1, inside,	2.532 "
Width of space between the inside of this lip (Fig. 1) and the outside of rim surrounding valve seat; that is, width of stricture of Fig. 1	.026 "
Width of lip, measured vertically inside	.10 "
Bevel of valve seat at ground joint from the vertical	deg. 39
Vertical height of bevelled valve seat	.181 in.
Horizontal width of bevelled valve seat	.146 "
Width of valve seat on the bevel	.232 "
Diameter of compensation flange, Fig. 3, outside of lip,	2.38 "
Width of space between the outside of this flange and lip and the inside of rim surrounding valve seat; that is, width of stricture, Fig. 3	.015 "

These flanges are both adjustable, up and down, and have been provided by complainants with screw-threaded valve stems and flange hubs, for the purpose of adjustment.

Experiments with complainants' Exhibit Webster Fig. 3, beginning with the lower edge of lip of flange, just level with the upper edge of rim surrounding valve seat, overlap = 0.000. Overlap then adjusted as shown in column 2, headed "Overlap."

TABLE V.

WEBSTER FIG. 3.

No. of Experiment.	Overlap, inches.	Warn. lbs. per sq. in.	Pop. lbs. per sq. in.	Close lbs. per sq. in.	Lbs. per sq. in.	REDUCTION. Per cent.	Per Cent Mean.
1	2	3	4	5	6	7	8
71	0.0	95.25	99	95.25	3.75	3.8	3.8
72	.0035	94.5	98	94.25	3.75	3.8	
73	.0069		99.5	87.5	12	12.1	12.3
74	.0069		100	87.5	12 5	12.5	
75	.0104		99.5	85	14 5	14.5	14.4
76	.0104	92.5	100	85.5	14.5	14.5	
77	.0139	92.5	100	81.75	18.25	18.25	18.4
78	.0139	92.75	99.5	82	17.5	17.57	
79	.0174	92.5	100	79	21	21	20.7
80	.0174	92	99.5	79.25	20.25	20.35	
81	.0243	92.5	100.5	72.5	28	27.9	27.9
82	.0278	92.5	100	71.5	28.5	28.5	28.5
83	.0300	92.5	100	68	32	32	32

Experiments with complainants' Exhibit Webster Fig 1. Beginning with the lower edge of lip of flange, just level with the upper edge of rim surrounding valve seat; overlap = 0.0. Overlap adjusted as shown in column 2, headed "Overlap."

TABLE VI.

WEBSTER FIG. 1.

No. of Experiment.	Overlap. inches.	Warn. lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	lbs. per sq. in.	REDUCTION. Per cent. Single.	Mean.
1	2	3	4	5	6	7	8
84	0.0		100	94	6	6	6.0
85	0.0		100	94	6	6	
86	.0035	94	100.25	92.25	8	8	7.3
87	.0035	92.25	99	92.5	6.5	6.6	
88	.0069	92.5	99.5	92	7.5	7.5	7.5
89	.0069	92.5	99.5	92	7.5	7.5	
90	.0104		99.5	91	8.5	8.5	9.0
91	.0104	92	100	90.5	9.5	9.5	
92	.0139	92	99.5	89.5	10	10.1	10.3
93	.0139	91	100	89.5	10.5	10.5	
94	.0174	91	100.25	88	12.25	12.2	12.3
95	.0174	91.5	100.5	88	12.5	12.4	
96	.0208	90	99.5	85.5	14	14.1	14.1
97	.0208	90.5	99.5	85.5	14	14.1	
98	.0243		100	84	16	16	16
99	.0243	90	100.5	84	16.5	15.9	
100	.0278		100.5	83	17.5	17.4	17.6
101	.0278	90.25	100.25	82.5	17.75	17.7	
102	.0313	91	100.5	80.5	20	19.9	19.9
103	.0313	91	100.5	80.5	20	19.9	
104	.0382	90	100	76.5	23.5	23.5	23.8
105	.0382	90	100	76	24	24	
106	.0451	90	100	71	29	29	28.9
107	.0451	90	100.5	71.5	29	28.8	
108	.0521	90	100.5	66.5	34	33.8	33.6
109	.0521	90	100	66.5	33.5	33.5	
110	.0555	90	100.75	64.5	36.25	36	35.9
111	.0555	90	99	63.5	35.5	35.8	
112	.0694	89.5	99	56	43	43.4	43.4
113	.0694	91	100	56.5	43.5	43.5	

With equal overlap the operation of this Webster safety valve, complainants' exhibit, agrees very closely with that of Richardson's patent. The action is every way as good. The adjustable overlap gives perfect control of the operation.

Adjusted as in experiments 71, 72, *or as in experiments* 84 *to* 89, *this exhibit, just as it is, lever and all, is an admirable safety valve, fit to be used on any stationary boiler of suitable size, at eighty to one hundred pounds pressure.*

Int. 6. Please examine defendants' Exhibits Webster Valves, Figs. 1 and 3, and state whether or not you understand them; if so, please give their dimensions, and the result of any trials which you may have made with them.

Ans. I understand said exhibits. On the 19th and 20th of January, 1886, I experimented with safety valves made by the Crosby Steam Gage and Valve Company, according to dimensions and drawings obtained from the drawings accompanying Letters Patent of Great Britain, No. 1955 of 1857, granted to James Webster, by Mr. William H. Harrison and by me. I have compared these two sets of measurements, and find them to agree.

The important dimensions are as follows: —

(1)	Diameter of steamway	1.22 in.
(2)	Diameter of lip of flange:	
	Fig. 1, inside of lip	2.54 in.
	Fig. 3, outside of lip	2.36 in.
(3)	Diameter of wall of chamber:	
	Fig. 1, outside of wall	2.49 in.
	Fig. 3, inside of wall	2.41 in.
(4)	Horizontal width of stricture:	
	(2.54—2.49=2.41—2.36) ÷2 . . .	.025 in.
(5)	Position of flange adjustable.	

TRIAL OF WEBSTER VALVE, FIG. 1.

Length of spring compressed to pop at one hundred pounds . . . . . 2.32 in.
Compression, to pop at one hundred pounds . . .18 in.
The result of the test is found in Table VII.

TABLE VII.

No. of Experiment.	Position of lip of flange.	Warn. lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	Lbs. per. sq. in.	Reduction. Per cent. Single.	Mean.
1	2	3	4	5	6	7	8
	Clearance.						
245	.015		100.5	96	4.5	4.5	
246	"	96	100.5	96	4.5	4.5	4.5
247	"	96	100.5	96	4.5	4.5	
248	.010		100.5	95.5	5	5	
249	"	95.5	100.5	95.5	5	5	5.0
250	"	95.5	100	95	5	5	
251	.005		100.5	93.5	7	7	
252	"	96	100.5	93.5	7	7	7.0
253	"	96	100.5	93.5	7	7	
254	"	96	100.5	93.5	7	7	
255	.000	97	100	93.5	6.5	6.5	
256	"	97	100	93.5	6.5	6.5	6.5
257	"	97	100	93.5	6.5	6.5	
	Overlap.						
258	.005	97	100	91	9	9	
259	"	97	100	91	9	9	9.0
260	"	97	101	92	9	9	
261	.010	97	101	88	13	12.9	
262	"	97	100.5	88	12.5	12.4	12.6
263	"	97	100.5	88	12.5	12.4	
264	.015	98	100.5	85.5	15	14.9	14.9
265	"	98	100.5	85.5	15	14.9	
266	.020	98	100	80	20	20	20.0
267	"	98	100	80	20	20	
268	.025	98	100	78	22	21.8	21.8
269	"	98	100.5	78.5	22	21.8	

TRIAL OF WEBSTER VALVE, FIG. 3.

Spring of No. 5 wire gauge, length, free . . . 2.50 in.
Length, compressed to pop at one hundred pounds . 2.32 in.
Compression for one hundred pounds = . . . 0.18 in.
The result of the test is found in Table VIII.

TABLE VIII.

No. of Experiment.	Position of lip of flange.	Warn. lbs. per sq. in.	Pop, lbs. per sq. in.	Close, lbs. per sq. in.	lbs. per sq. in.	Reduction. Per cent. Single.	Mean.
1	2	3	4	5	6	7	8
	Clearance.						
270	.015	Rarely	100	98	2	2	
271	"	any	100	98	2	2	
272	"	warning,	100	98	2	2	
273	"	sometimes	100	98	2	2	2.0
274	"	just	100	98	2	2	
275	"	distin-	100	98	2	2	
276	"	guishable.	100	98	2	2	
277	.010	99	100	97	3	3	
278	"	99	100	97	3	3	3.0
279	"	99	100	97	3	3	
280	"	99	100	97	3	3	
281	.005	99	100	96.5	3.5	3.5	
282	"	99.5	100.5	97	3.5	3.5	
283	"	100	100.5	97	3.5	3.5	3.5
284	"	100	100.5	97	3.5	3.5	
285	"	100	100.5	97	3.5	3.5	
286	.000	99.5	100	93	7	7	
287	"	99.5	100	93	7	7	7
288	"	99.5	100	93	7	7	
	Overlap.						
289	.005	99.75	100	90.5	9.5	9.5	
290	"	99	99	90	9	9.1	9.3
291	"	99	99.5	90.5	9	9	
292	.010	97.5	98.5	83	15.5	15.7	
293	"	97.5	98.5	83	15.5	15.7	15.7
294	"	97	98.5	83	15.5	15.7	
295	.015	99	100.5	84	16.5	16.4	16.6
296	"	98.5	101	84	17	16.8	
297	.020	99	100	75	25	25	25
298	"	98	100	75	25	25	
299	.025	98	100	70.5	29.5	29.5	29.5
300	"	98	100	70.5	29.5	29.5	

The seven experiments, Nos. 270 *to* 276, *are quite remarkable. The pop was clear, full and distinct, generally without distinguishable warning, the closure prompt, full and tight, the reduction,* 2 *lbs.* = 2 *per cent, and the pressure was kept uniformly between the limits of one hundred pounds popping pressure and ninety-eight pounds closing pressure. The action was in all respects admirable. The subsequent experiments, Nos.* 277 *to* 288, *are all at practically useful degrees of reduction,* 3, 3.5 *and* 7 *per cent, and Nos.* 289, 290, 291, 9 *per cent is, for good boilers, in my judgment, as good as any of the preceding.*

The whole series of experiments is remarkably regular and consistent; each one confirms the accuracy of all the rest.

TESTIMONY OF MR. HARRISON.— (Record, page 232.)

Int. 9. Were you present with Mr. Hoadley when the trials were made by him of the complainants' Webster Valve Exhibits in this case; and, if so, did you take notes of those trials, and how do those notes compare with the statements made by Mr. Hoadley of those trials, as found in his answer to Int. 5?

Ans. I was present, and took notes. My figures are the same as those of Mr. Hoadley.

Int. 10. Were you present at the trials made of defendants' Exhibits Webster Valves, Figs 1 and 3, mentioned by Mr. Hoadley in his answer to Int. 6; and, if so, did you take notes of those trials, and how do they compare with the statements made by him of them?

Ans. I was present, and took notes. My figures are the same as those of Mr. Hoadley.

Int. 11. Please examine the direct acting spring connected with defendants' Exhibit Webster Valve, Fig. 3, and state whether that is the spring referred to by Mr. Hoadley as used in making the trials; and, if so, describe it.

Ans. It is the same spring described by Mr. Hoadley, and I find his description of it correct. That spring was used in the experiments on both valves.

Int. 12. Whether or not you obtained the dimensions of the several parts of the Webster valve, Figs. 1 and 3, referred to, as shown in the drawings of the James Webster patent given in the record in this case; if so, please to compare them with the dimensions of the corresponding parts of the Webster valve exhibits, Figs. 1 and 3, and also compare them with the dimensions given by Mr. Hoadley in his answer to Int. 6.

Ans I have obtained those dimensions,— that is, the dimensions from the Webster patent drawing,— and I find them to agree with the dimensions of the valves exhibited. I find that Mr. Hoadley's dimensions agree with mine in every particular, except that in his description of Webster Fig. 3 he gives diameter of outside of lip of Fig. 3, 2.36 inches, the correct diameter being 2.37 inches; and Mr. Hoadley gives for the same valve, Fig. 3, the diameter of inside of wall 2.41, and it should be 2.42, leaving the horizontal width of stricture .025, as before. This would make no difference in the action of the valve. I should add that two additional dimensions are useful, which I will give, namely:—

For Fig. 1, diameter at top of ground joint, 1.48 in.

For Fig. 3, same, 1.48 in.

Int. 13. Please state whether or not you have made tests of the said defendants' Exhibits Webster Valve, Figs. 1 and 3, using a lever and spring or scales for holding the valve to its seat; if so,

please describe said level and spring and produce the same, and also give the results of your trials.

Ans. I have made such tests, and now produce the apparatus referred to.

[*The levers produced are marked* (1) "*Lever for Webster, Fig.* 1, *J. G. S., Master*"; (2) "*Lever for Webster, Fig.* 3, *J. G. S., Master.*"]

The spring used is defendants' Exhibit Lever Spring, No. 10 wire, etc.

The length of the levers from fulcrum to centre of hook is 16 inches in each case; length from fulcrum to vertical axis of valve is 2 inches in each case; the lever ratio, then, is 8 to 1.

I will give first the experiments with Webster valve, Fig. 1, fitted with a lever and the spring described, which are as follows: —

MR. HARRISON'S EXPERIMENTS WITH WEBSTER VALVE, FIG. 1.

Remarks.	Overlap. Inches.	Extension of Spring. Inches.	Lift of Valve. Inches.	STEAM PRESSURE IN POUNDS PER SQUARE INCH Warn.	Pop.	Close.	Reduction.
Clearance,	.01	1.00	.046	98	100	98	2
"	"	"	"	98	100	98	2
"	"	"	"	98	100	98	2
Clearance,	.005	1.00	.054	96½	100	96½	3½
"	"	"	"	96½	100	96½	3½
Flush,	.00	1.00	.058	96	100	96	4
"	"	"	"	96	100	96	4
"	"	"	"	96	100	96	4
Overlap,	.005	1.05	.06	95½	100½	95½	5
"	"	"	"	95½	100½	95½	5
"	"	"	"	95½	100½	95½	5
Overlap,	.010	1.10	.064	94	100	92	8
"	"	"	"	94	100	92	8
"	"	"	"	94	100	92	8
Overlap,	.015	1.10	.075	94½	100	88	12
"	"	"	"	94½	100	88	12
Overlap,	.025	1.15	.078	96	10	82½	17½
"	"	"	"	96	1000	82½	17½
Overlap,	.04	1.15	.103	96	100	69	31

With defendants' Exhibit Webster Valve, Fig. 3, fitted with its lever and the same spring described for the valve Fig. 1, I made the experiments, the results of which will be seen in the following table: —

MR. HARRISON'S EXPERIMENTS WITH WEBSTER VALVE, FIG. 3.

Remarks.	Immersion. of Flange. Inches.	Extension. of Spring. Inches.	Lift of Valve. Inches.	STEAM PRESSURE IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Clearance, =	.005	.95	.04	98	100	97	3
"	"	"	"	98	100	97	3
Flush, =	.00	.95	.041	97	100	93	7
"	"	"	"	97	100	93	7
Immersion, =	.005	.95	.044	97	100	89	11
"	"	"	"	97	100	89	11
Immersion, =	.01	.95	.05	97	100	83½	16½
"	"	"	"	97	99½	83	16½
Immersion, =	.025	.95	.077	97	100	72	28

Int. 14. Please define the words noted in the margin of the tables given, "Clearance," "Flush," "Immersion" and "Overlap."

Ans. "Clearance" means the vertical distance that the lower edge of the lip is above the wall.

"Flush" applies to the location in height of the lower edge of the lip, and means that said lower edge is level with the upper edge of wall.

"Overlap" means the distance that the lower edge of the lip is below the top of the wall. This expression occurs in the table referring to Fig. 1.

"Immersion" means the vertical distance that the lower edge of the lip of the compensating flange is below the upper edge of the wall. This expression occurs in the table referring to Fig. 3.

Int. 15. In Webster's patent is the following: —

"The short case or hollow cylinder *g* may be dispensed with, and the sliding collar or flange *e* may be dropped down on the stem *c*, so as to rest on the top of the valve *a*."

Have you made a valve under that direction, and tested it? If so, produce it and describe it, and give its results under trial.

Ans. Such valve was made under my direction, and tested by me, and I produce it.

[*Valve produced is marked "Defendants' Exhibit Webster Valve, with Flange resting on Top of Valve, J. G. S., Master."*]

This valve has the following dimensions: —

Diameter of steamway	1.22 inches.
" " valve at top of ground joint	1.48 "
" " outside of valve seat	2.49 "
" inside the lip of overhanging flange	2.54 "
Width of the annular outlet	.025 "
Depth of lip below its flange	.10 "
Thickness of the head of the valve above its seat	.08 "
The overlap then is adjustable from nothing down to	.02 "

These dimensions I obtained from Fig. 1 of the patent drawing, and the directions for cutting down the wall of said valve from Webster's specification.

To the above-described valve a lever and suitable attachments for getting a strain on the spring are fitted.

The length of this lever from fulcrum to centre of hook is	16 inches.
The horizontal distance from the fulcrum to the vertical axis of the valve is	2 "

The lever ratio, therefore, is 8 to 1.

The spring used is the same No. 10 wire spring which has been described as used on the last two defendants' Webster Exhibits.

The observed results of the experiments I have embodied in the following short table: —

MR. HARRISON'S EXPERIMENTS WITH WEBSTER VALVE, FLANGE RESTING ON TOP OF VALVE.

REMARKS.	Overlap. Inches.	Extension of Spring. Inches.	Lift of Valve. Inches.	STEAM PRESSURE IN POUNDS PER SQUARE INCH. Warn.	Pop.	Close.	Reduction.
Greatest possible Overlap, =	.02	1.10	.058	None	100	85	15
	.01	1.10	.045	95	100	92	8
	.005	1.10	.045	95	100	94	6

Int. 15½. Where was the flange at the overlap noted in the table at .02 inch?

Ans. It was resting on the top of the valve, and .02 inches was the greatest possible overlap for the lip of this valve.

Int. 16. The other positions, noted in the margin, designate what?

Ans. They designate the distance that the lip of the valve is below the outside upper edge of the valve seat.

Int. 17. *What was the character and action of all these Webster valves described by you as tried at the trials?*

Ans. *The action was good. The valves opened well, good lift, relieved the boiler according to the amount of the overlap, and closed of their own accord.*

Mr. Forbes alone (Record, page 292) criticised defendant's Webster valves as being at variance with the Webster drawings, and, in action, poor; but when asked for data of his examination and trial he could give neither. Indeed, his charge that Mr. Hoadley was in error in stating the diameter of the outside wall of Fig. 1, and so narrowing the stricture, was met by himself in admitting that, according to his own dimensions given in the Record at the Rules, Mr. Hoadley was correct, Mr. Forbes's dimension being 2.4896 inches, and Mr. Hoadley's 2.49 (Record, page 292, Int. 28 and answer; Cross-Ints. 120, 121 and 122, and answers, page 308). The only importance of this lies in the charge, by Mr. Forbes, that Mr. Hoadley's departure of only .02 inches influenced the action of the valve. But, as we have seen, Mr. Hoadley's valve conformed to his and Mr. Forbes's measurements.

There is not the slightest doubt of the economical and beneficial

advantages to be found in the Webster valve. The careful and clear statement made by Messrs. Hoadley and Harrison, so easily to be verified, cannot be brushed aside by a witness by a mere statement of his manipulation and observation of these valves without giving results of his efforts. What he testifies he could not do exemplifies more his inability to do than any inefficiency of the valves.

Now, in view of this evidence, upon what ground was the master justified in refusing to require the appellants to prove before him the money value of the Richardson improvement, or how can he be justified in disregarding all evidence going to show what could, in fact, be accomplished by steam safety valves known to the prior art, and assessing the entire profits and savings of manufacture against the appellants as infringers? The appellants have brought themselves entirely within the line of the cases quoted *supra* on the rules to be observed in taking an account of profits against defendants for infringement of Letters Patent. The master seems to have supposed that this Court had before it the Webster valve, and had found that it was insufficient to affect the complainants' (appellees') patent. So, indeed, it did upon the question of the ability of the Webster patent to anticipate the Richardson invention. The only question before this Court was, whether the Richardson patent could be sustained against the defendants' (appellants'). The question of the value of the Richardson patent in dollars and cents, on the question of the infringer's liability, was in no sense before it. This question was to be determined for the first time by the Court below, in the proceedings before the master on an accounting under the mandate of this Court, and it was, therefore, entirely competent for the defendants to show precisely what could be, and what could not be, accomplished by valves made according to the Webster patent. The appellants put this proof fully before the master, as we have seen. The appellees did not undertake to say that this testimony was not true. It was entirely competent for them to show exactly the loss which resulted in the consumption of fuel from the employment of the Webster valve, and compare the same with the results from the use of a valve constructed according to the Richardson principle.

If the difference had been large, they would have recovered accordingly, and in case, as previously stated, it had appeared that the disadvantages in the use of a Webster valve were so great as to deprive it of any commercial value by the side of a Richardson valve, then the master would have been justified in finding the entire profits; but the premises do not exist for such a finding in this case.

It is because the appellees would not submit any proof tending to show what was in fact the comparative value of the Richardson device with others previously known, that the master erred in not applying the rule as laid down in the cases cited above, and holding that they had failed to show any proper basis upon which a recovery of profits beyond a nominal sum could be awarded against the appellants.

This Court, we repeat, did indeed find that valves of the Webster type, although containing all the elements, generally speaking, found in the Richardson valve, did not anticipate the Richardson structure, and for the reason that there was a peculiar characteristic given to the huddling chamber, which has before been repeatedly mentioned. But it by no means follows that this Court decided that, on an accounting for the profits due to the use of the Richardson improvement, the master should not follow the ordinary rule of ascertaining the difference in value between the patented improvement and the thing or things which preceded it. This Court did not undertake to forestall this finding.

This principle is happily stated in the observation of Mr. *Justice* GRAY, in a recent case in this court (Tilghman *v.* Proctor, *supra*), in reviewing the action of the master, who had given too much weight to matters in the original record, touching the utility of the invention,—

"That the question of the practical economy of the patented process, as compared either with older processes, or with the subsequent modifications used by the defendants, is distinct from the questions of utility and infringement heretofore determined" (page 157.)

That question is one to be determined, in the first instance, in the accounting proceedings before the master. It is an entirely different question from that which belongs to the determination of the

merits of the controversy. It is a question of the ascertainment of the value which has accrued to the defendants from the use of the complainants' improvement. To settle that question correctly, it is necessary to get at the value in money of the complainants' improvement over and above the things in the art which preceded it. We will illustrate our position in this way: Let us suppose that the Webster valve has been made and sold in the market as a steam safety appliance, and that, to make the illustration complete, there is not, and can not be, any question as to the identity of the device with the thing described in the Webster patent, and that, as a fact, while it has a supplementary steam chamber, such chamber has not the peculiar characteristics of the Richardson huddling chamber. Now, suppose that a defendant who is manufacturing steam safety valves, actually employs the particular improvement set forth in the Richardson patent, by constructing his huddling chamber according to the Richardson idea, and we will further suppose that suit has been brought against him for such infringement, and that he has set up in defence the Webster patent, on the ground that it in fact anticipated the Richardson, and that there was no invention in Richardson in view of the Webster.

To make the parallel complete, we will further assume that the record did not disclose the fact that Webster valves were sold in large quantities as a regular manufacture upon the market. The decision of this Court might well be, as it has been in the present case, viz., that the Richardson patent contained a feature of construction which was not found in the prior Webster, and remand the case to the Circuit Court. Can it be supposed that it would not be entirely competent for the defendant, on the entirely new question to be tried before the master, which relates solely to the sum of money which he is to pay for the use of the Richardson improvement, to put in proof the fact that Webster valves were sold and used, and show their economy in comparison with the economy of Richardson valves? In case such proof should show a difference of ten per cent in favor of Richardson valves, then such would be the proper measure of the defendant's liability. If, however, it should appear that there was actually no advantage in the Richardson

device over the Webster, or if it should appear that the Webster device was more economical than the Richardson, then there could be no finding for profits as against the defendant, and, for the same reason that no profits or advantages had accrued to him. The present case, as it appears in the record before the master, is not distinguishable from the illustration which we have supposed.

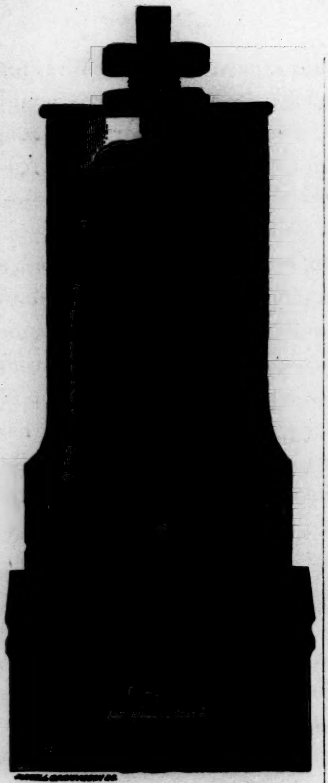
True, Webster valves have not been constructed and sold as a merchantable article, but it is entirely open to the appellants and to all the rest of the world to make and sell them, and for the same reason it is open to the appellants to prove their economy in order to arrive at a proper measure of value for the Richardson patent as a basis for his accounting to the appellees. But all this proof has been disregarded by the master, and he has proceeded upon the theory that the entire profits derived from making and selling valves should be paid over by the appellants to the appellees.

Ninth Error.

While the discussion of the prior errors is applicable to the discussion of this, a special consideration is here given because the master refused to ascertain the value of the contribution of the inventions of Crosby, which are embodied in the valve made by the appellants, and to deduct the same from his finding in favor of the appellees.

In awarding to the appellees the whole of the profits, he has manifestly given to them *the same advantages as if they were the owners of the Crosby inventions.*

We have already pointed out that the theory upon which he has taken the accounting is radically unsound from beginning to end. The Richardson valve was not the first steam valve which had an initial area, a supplementary area, and a steam chamber in combination; the Webster valve preceded it for very many years. Consequently, Richardson at most was an improver of a known structure; and, while he is entitled to recover from an infringer the money value which has accrued to him from the use of the improvement, t is necessary that the master, in ascertaining the sum to be pai ,



SECTIONAL VIEW OF THE CROSBY VALVE HELD TO INFRINGE THE RICHARDSON PATENT OF 1866.

Description. — A, valve body; B, valve; C, well for valve guides X X; E, passages from the well to the air; G, ring for regulating the size of the passages; V and W, the two annular seats upon which the valve rests.

Operation. — When the valve B rises from its seats under a pressure of steam below it equal to or greater than the force due to the compression of the spring above it, a greater portion of the steam escapes into the air at the outer seat V. Meanwhile, a small part of it flows over the inner seat W into the well C, and there, finding its escape into the atmosphere retarded by the partial closing of the passages E, E, developes an increasing pressure which acts upon the under side of the valve B within the inner seat W, additional to the pressure of the steam exerted upon the remaining portion of it, being the annulus between the outer and inner seats, when the valve first lifted. The initial and this additional pressure together so compress the spring that the valve will rise higher than otherwise it would with the action of the initial pressure alone, at which the valve opened, and thereby gives relief to the steam boiler. Compare sectional view of Richardson valve, 1866, opp. page 49.

should first obtain the requisite and proper data for making his computation; and this can be done only upon a comparison of the economy resulting from the Richardson valve with that resulting from the formerly known Webster valve. When the appellants sold their valves, they sold a structure which contained, under the judgment of the Supreme Court, the Richardson improvement. It also contained the inventions to Crosby set forth in his two Letters Patent of 1875 (See Record, No. 127, Oct. Term, 1884, pages 74 and 76). The profit which the appellants received, or the difference between cost and sales, may be presumed to be a matter due to what is contained in the valve free to everybody to make, plus that which belongs to Richardson, plus that which specially belongs to Crosby. But the master has refused to take this view of the case, and has adjudged the entire profits of the manufacture to be due to Richardson.

George H. Crosby, the superintendent of the defendant company (appellants) from its origin, testified in the principal case that it was not until nearly five years after they had introduced their safety valves, made in accordance with the Crosby patents, to the public, that he first heard of or saw the so-called Richardson valve, which was then offered for sale in competition with the Crosby valve;

and then it was, in its appearance attractiveness and convenience, modelled upon the design of the Crosby valve. (Rec., No. 127, Oct. Term, 1884, page 238.)

The Crosby valves made by them, and accounted for in this proceeding, would not work more economically or better than the Richardson valve constructed like the drawing and under the directions of the Richardson patent, were it not for the employment of a feature which is not to be found in the Richardson valve of the patent. This feature is the open and untrammelled outlet at the outer circumference of the valve when it is in action. Let that be closed, and all the steam turned through the inner chamber and outward through the passages in the arms into the open air, if it were possible, and the loss of steam would correspond to the loss of steam of the valve of the Richardson patent of 1866, as it would then correspond to the operation of that valve. But, with the additional outlet, which becomes full and free at the opening of the valve, provision is made for so free a discharge of steam that the former action of the valve is converted into a new one, which results in only a small loss of steam before the valve closes. This is wholly due to the inventions of Crosby, and belongs exclusively to the appellants. It is a valuable characteristic of their valves.

On this point Mr. CROSBY testified as follows (Record, page 281): —

BOSTON, Feb. 3, 1887.

Int. 19. Please give your name, and state whether or not you have before testified in this proceeding.

Ans. George H. Crosby; I have.

Int. 20. How long have you been superintendent of the defendant company?

Ans. Since its organization.

Int. 21. As superintendent did you have the control and direction of the making of the defendants' valves which have been accounted for in this proceeding?

Ans. I did.

Int. 22. How long have you been familiar with what are called "pop safety valves," as found in use?

Ans. In the neighborhood of fifteen years.

Int. 23. Assuming the Crosby valve to be a safety valve so organized that it has an initial area, an additional area, and a huddling

chamber beneath this additional area, having discharge orifices leading from such huddling chamber through the arms supporting such huddling chamber to the open air, whose area is always smaller than the area of the opening at the ground joint over which the steam passes into the huddling chamber when the valve rises, would a valve so contrived have any advantage or saving accrue to it in use over the defendants' Exhibit Complainants' Valves as designated,—shown in dimensions, and the result of whose operations is found in a table given by William Burnett as a part of his answer to Int. 12, on page 491 of the printed record of the accounting proceedings,—these valves having the area of opening from the supplemental chamber at the lip always greater than the area of opening at the ground joint when open, assuming also that the statements of the tables are correct?

Ans. Understanding, by the conditions of the question applicable to the Crosby valve, that the huddling chamber referred to is the supplemental chamber at the centre of the valve, the discharge orifices are the holes or passages in the arms radiating from the central chamber and leading to the open air, and the ground joint is the inner ground joint at the circumference of this central chamber, such a valve, unless it had a large outlet independent of the parts named in the question, through which the steam from a boiler to which it might be attached could freely pass to give relief to the boiler, would be substantially worthless as a safety valve, although it might be an operative one; but the Crosby valve has such an outlet at the outer circumference of the initial area when the valve rises to blow, which is unobstructed and free to allow the steam to go into the open air and relieve the boiler by reducing the pressure from two to more pounds as may be desired. The Crosby valve thus made is a prudent one in its operations. According to the statements of loss when in use of the defendants' Exhibits Complainants' Valve shown in the table inquired about, there are also prudent safety valves for use, and comparing them with the Crosby valve last referred to, I do not see that there would be any difference between them as prudent operating valves, so that any greater advantage would accrue to one over the other.

Int. 24. Did the defendants' valves accounted for have an outlet at the circumference or the initial area such as you have spoken of?

Ans. They did.

Mr. Francis T. Simmons testified of the advantage and benefits to be found in the Crosby valve over other valves, and the grounds of his ability to so successfully introduce it to the public as follows (Record, page 184):—

BOSTON, Nov. 2, 1886.

Int. 1. Please state your name, age, residence and occupation.

Ans. Francis T. Simmons; thirty-one; Chicago, Ill.; wholesale hats, caps, etc.

Int. 2. Whether or not you have ever been employed by the Crosby Steam Gage and Valve Company; if so, when?

Ans. I have; from February, 1878, until May, 1886.

Int. 3. During that time what was your duty as an employé?

Ans. That of salesman.

Int. 4. As a salesman, was it your custom to travel in the country?

Ans. It was.

Int. 5. To what extent have you travelled for them as a salesman?

Ans. In all States of the Union except, I think, two, — Texas and Arkansas, — and all the Territories except four, — Indian, Dakota, Washington and Montana.

Int. 6. To what extent did you become acquainted with the trade in the products made and sold by the defendants?

Ans. To the fullest extent compatible with my position.

Int. 7. What were the kinds of goods which you were selling during that time?

Ans. All the products of the Crosby Gage Company.

[*No Int.* 8.]

Int. 9. Did those products include safety valves?

Ans. Yes.

Int. 10. What classes of customers did you visit for the purpose of selling safety valves?

Ans. Railroads, farm and portable engine builders, marine engine builders, and boiler makers of all kinds.

Int. 11. How extensively did you visit railroads?

Ans. I aimed to visit all of them.

Int. 12. Are you familiar with the kinds of safety valves in use during the year 1878? State them.

Ans. I am. The common safety valve, either spring or weight loaded, the Richardson pop valve, the Crosby pop valve and the Ashcroft valve; of the latter I knew very little at that time.

Int. 13. Were there any additions to these at about that time? if so, please state them, and the year they came to your knowledge.

Ans. The Kunkle valve came first to my observation in 1879; since then there have been several, the Orme, the Ashton, the Scoville, the Collier, the Lynde, the Case and Bailey (Detroit), the Lunkenheimer, the Thomas Badgeley and Wentworth valve, the Cowie valve, the King Iron Works valve (Buffalo); those are all I recall.

Int. 14. Prior to 1879, and during 1879, in what form did you meet the Richardson valve?

Ans. In the then locomotive form, the construction being two studs and a yoke and a spring open without encasement.

Int. 15. Please examine the cut on page 2 of complainants' catalogue of 1879, and state how that compares with the valves you have just described.

Ans. I find it much the same in general appearance, and, as near as I can tell, the same, with the exception of the adjustable ring here shown, and the boss evidently cast on the yoke.

Int. 16. How long from 1879 onward was it before you saw any other form of a Richardson valve, so called, in use on locomotives?

Ans. I can't state exactly the time. It was after that time that I began to see them with the adjustable ring, the same external form of valve. I do not remember having seen the boss at any time.

Int. 17. Whether or not you saw, and when, any other modification of the Richardson locomotive valve.

Ans. I never saw any other modification of the so-called Richardson valve, for the name soon changed to the Consolidated valve.

Int. 18. As such valve, what changes, if any, in it came to your observation?

Ans. The abolishing of the external form of the valve wholly, and in its stead an encased valve having a strong resemblance to the Crosby valve and embracing some of its good qualities, among them, notably, the convenience of application to the dome cover of a locomotive.

. . . . . .

Int. 22. About when did you first see the encased locomotive (complainants') valve?

Ans. I can't state positively, but know that the first time I saw it, whereby it made an impression upon me, was not prior to 1882.

. . . . . .

Int. 28. To what extent did you make observations of the use and working of locomotive valves during your employment by the defendants, and what were the methods adopted by you?

Ans. To the greatest extent possible, and gained from all sources; principally the observation of the practical working of the valves, as obtained by riding upon locomotives, and watching carefully the operation of safety valves under all circumstances.

Int. 29. In 1878 or 1879, whether or not, if you know, there were difficulties attending the working of locomotive valves; if so, state what these difficulties were, and what were the kinds of valves giving them?

Ans. I know there were difficulties existing mainly in the use of the Richardson valves as manufactured; and, as there were then only two pop valves in anything like general use, the Richardson would embrace the faulty valve; the faults being, first, that the Richard-

son valve had a bevelled seat, was loaded by a helical spring, which, in its action, would, in common with all helical springs, cock or deflect, and, there being no way of changing the relative location of the valve to its seat, the tendency to cock of the spring would cock the valve into its seat, and, in a short time, cause the valve to leak at that point; the dynamic action of the spring would also hammer down the valve seat, so that the effect would be to allow more steam to escape at time of action than was the case when the valve was new and fresh. These, added to the fact that the spring, in cold days, in cold climates, was wholly unprotected, and subject to intense extremes of heat and cold, caused by the opening of the valve at a time when the spring was as cold as the atmosphere, had a tendency to weaken the spring, and cause it to break, and render it unreliable. Also, the unencased spring offered peculiar temptations to engineers to exceed their limits of pressure, they being enabled to block the spring easily and without detection, thereby rendering the valve wholly inoperative; the operation of blocking being simply to stick a piece of wood or a spike between the coils of the spring, thus rendering it incapable of action, and locking the valve firmly to its seat.

Int. 30. How long after 1879 did you observe such faults of the Richardson valve?

Ans. Ever and as long as that type of valve existed, which was up to the time of my leaving the employ of the Crosby Company.

Int. 31. Whether or not these faults which you have given can exist in the Crosby locomotive valve, and, if not, please state your reasons.

Ans. I consider it practically impossible, and found that they did not exist by actual contact with the valve, the reasons for their not existing being, —

First. That the seats were flat, and, no matter how much the spring might deflect or cock, the seats being on the same plane, so that when the valve closed the valve would strike on its periphery at a point outside of the seat and immediately come to its seat without damage to itself, as there was enough metal left on the periphery of the valve head to allow sudden contact and consequent indentation to occur without impairing the tightness of the valve.

Second. The seat could never be hammered down, therefore avoiding the change or increase of loss of steam when in action.

Third. The case of the valve so covered the spring as to keep a more nearly equalized temperature surrounding the spring, acting like an overcoat for it.

Fourth. The spring being thus covered prevented its being tampered with by the engineer, and was the feature of the four most commendatory to the master mechanic at the time of offering for trial or sale, he making it a rule to seal the valve after setting

it, thereby robbing the engineer of an opportunity to carry more steam than allowed.

Int. 32. Were valves, to your knowledge, discarded by railroads on account of the faults which you have just described?

Ans. They were.

Int. 33. For such valves discarded, do you know what valves were introduced in their place? If so, please state.

Ans. I do. The Crosby valve was in many instances, in fact in all instances under my observation, substituted for them.

Int. 34. Was this substitution the result of a mere representation by you, as a salesman, or as a matter of test?

Ans. Not by my representation, but by actual test of the Crosby valve. I do not recall a case to the contrary.

Int. 35. What size Crosby valves of those given by you were generally adopted?

Ans. The 2½-inch valve.

Int. 36. Is it the locomotive valve represented by the cut in Crosby Catalogue A (fly leaf)?

Ans. It is.

Int. 37. Do you know the price or cost in 1879 and 1880 to the railroads of the Richardson valve which you have mentioned above?

Ans. Approximately, yes.

Int. 38. What was it?

Ans. The conditions were various under which this valve was owned by railroads. The only price which I know of was the price at which railroads made their valves and owned them under the shopright license, which a large number of the railroads had at that time, and my knowledge of the cost is that which was furnished me by master mechanics, varying —

[*Further answer giving hearsay evidence objected to.*]

Int. 39. At that time, 1879 and 1880, at what price were you selling to railroads the Crosby locomotive valve?

Ans. Twenty-five dollars each.

Int. 40. Do you know whether that price was greater or less than the price to railroads of Richardson valves used by them?

Ans. I do not, of absolute knowledge.

Int. 41. To what extent did the price affect the introduction of the Crosby valve then?

Ans. To a great extent, the claim being that the Richardson valve could be made and owned at two thirds (⅔) less price, or approximately that amount, varying in some dollars and cents with different roads.

[*Adjourned.*]

Nov. 3, 1886.

[*Witness says:*]

On reflection, with regard to valve price, I wish to amend my

testimony in answer to Int. 39. I said twenty-five dollars each; there might have been some times when it was sold for less. I do not recall such cases, but I wish to prevent any error in this regard.

Int. 42. Have you ever known of a Crosby valve, having qualities such as you have described, to be in use any length of time without repairs? If so, please state how long.

Ans I have known instances where the Crosby valve has been in use for a long time without repairs, notably in the case of a valve on the Burlington, Cedar Rapids and Northern Railroad. That, to my knowledge, was in use more than four years, and remained intact and perfectly operative at the end of four years, and was not even at that time subject to repair.

. . . . . .

Int. 47. What kind of safety valves were the persons using at the time of the introduction by you of the Crosby patent?

Ans. With very few exceptions, the common safety valve, either ball or spring loaded, or of that which is known as the spring-balance valve, which consisted of a lever held down by a spring at the outer end, and provided with an index and scale, the point of opening of the valve being determined by the tension of the spring as regulated by a screw and nut, commonly called the "Salter spring balance," these cases being either that or a modification of it. Up to the time of August, 1878, I had never seen a safety valve which could be applied to a farm or portable engine with any adaptability except the common safety valve heretofore described, and the Crosby pop valve. In August, 1878, I first saw what was known as the Kunkle valve, which I saw as a sample valve, and not in use at that time. The first time succeeding that that I ever saw any other safety valve than those heretofore mentioned was in the fall or late summer of 1880, when I saw a valve known as the "Consolidated valve," which I saw as a sample valve, and saw entered in test against the Crosby valve. Since that time I have seen other valves on the pop-valve principle applied to farm engines.

Int. 48. Please to state what these exceptions were, referred to in your last answer.

Ans. The Kunkle and the Consolidated valve heretofore mentioned, the Lunkenheimer, the Orme, the Scoville valve, the Thomas Badgeley and Wentworth valve, a valve made by the Watertown Steam Engine Company, not strictly a pop valve; these are all that I recall.

. . . . . .

Int. 57. In the introduction of farm engine valves, whether or not trials were made, and, if so, in what way.

Ans. In certain cases trials were made, notably, in the late sum-

mer or fall of 1880, a trial was had at the shop of C. Aultman & Co., Canton, Ohio, between the Crosby valve and the Consolidated valve of even size and conditions of test as to the efficiency of the valve in action, and as to the relative relieving qualities of the valves and the amount of steam lost in the action of the valves, which resulted in favor of the Crosby valve, and the subsequent sale of the Crosby valve to that company for that year, which was made in a contract form, covering the needs and requirements of that company for pop valves for every engine of their build for the ensuing year. Notably, also, at Russell Company's shop at Massillion, Ohio, the day succeeding the test formerly mentioned in this answer, a test was had resulting in exactly the same way as that of C. Aultman & Co., heretofore mentioned.

. . . . . .

Int. 61. Prior to 1879, who, if any one, were competitors of the defendants in the introduction and sale of farm engine valves, if you know?

Ans. There were no competitors prior to 1879 in the manufacture or sale of a pop valve for farm engines, excepting possibly Kunkle, who was about that time perfecting his valve, but which I never saw in use prior to 1879.

Int. 62. Were the Crosby farm-engine valves in 1879 substantially of the same character and peculiarities as prior to that time?

Ans. They were.

Int. 63. In the introduction of the Crosby valve by you, what were the peculiarities which led to a successful use of them?

Ans. Size of the valve, its portability, its ease of application, its durability, as suggested by the fact that there was no ball to swing, no dependent spring at the end of a lever to get out of order, its reliability, from the fact that it was non-tamperable; the troubles of the farm-engine builder being, — the old valve was cumbersome, and in the movable qualities of the engine, it having to be taken from place to place, often under steam pressure; more especially in the class known as "traction engines," under any device which they had, and the liability was great of the valves jumping and losing steam whenever the engine passed over any obstacle or rough place. It recommended itself to the builder, in that it took especial good care of the engine when such engine was placed in the hands of farmers who were incompetent of judgment regarding over-pressure of steam; it often being the case with a lever valve that the farmer would weight it in excess of its capacity, thereby hazarding both the engine and, incidentally, the reputation of its builder; it being the custom for the Crosby Company to seal or pin the valve, so that it could not be changed as to pressure without destroying a part or the whole fabric of the valve.

Int. 64. Whether or not in the introduction of the Crosby farm-

engine valve you found difficulties to be overcome; if so, of what character were they?

Ans. I found difficulties in overcoming the natural prejudice on the part of the farm-engine builder on the points of noise from escaping steam in scaring horses; also a claim, however correctly founded, that the valve, by its sudden relief, would weaken the boiler by its sudden and instantaneous action; in other words, relieve the boiler too quickly. I found the class of men who were building farm engines during the early part of my introduction of the Crosby valve to be mainly ignorant of the theory of steam engineering. They had been threshing-machine builders; therefore, the men to whom I went for orders were naturally averse to entertaining anything that suggested complication; and I could not, with effect, talk about the added area and other points relative to pop valves. I found the best policy to be to say as little as might be regarding the hidden qualities of the pop valve, and depended mainly upon the portability and convenience of the Crosby valve in its contained and external form. The size of the valve being no greater than the common valve which it displaced, and which relieved the boiler satisfactorily, it was not necessary to urge the superior relieving qualities of a pop valve, as they were oftentimes in excess of the demand.

I found also inconvenience in that I had frequently to suggest and insist upon locating the valve at a different place farther above the water line of the boiler than that occupied by the old style of valve. This precaution was necessary in many cases to avoid what is known as drawing water on the part of a pop valve. Therefore, to sum up, I relied more upon the shape and size of the valve than upon its peculiar merits as a pop valve.

Int. 65. After February, 1879, what parties did you find in the market attempting to compete for the farm-engine trade in the sale of valves?

Ans. Up to 1880 I had no competition. During and after 1880 there came into the market, actively, Kunkle, Consolidated, the Orme and the Lunkenheimer valves, — I think in about the order in which the names are mentioned.

Int. 66. When the valves of these parties came to your notice, in appearance how did they compare with the Crosby valves which you have been introducing and selling to farm-engine builders?

Ans Prior to 1880 there was no peculiarity of appearance, because there were no valves. As they came out in their order, they were as nearly like the Crosby valve in appearance as it was possible to make them, and after the change of the Crosby Gage Company in lever, which was changed from the lever like the one shown in Crosby Valve for Farm Engines, 1¼ inch, J. G. S., Master, to the one shown in Crosby Catalogue D, Moore 37, in cut, page 37, valve marked "Portable and Farm Engine Style," the Consolidated valves

very soon after appeared with a change in their lever identical with that of the Crosby, and in every feature possible copied the Crosby form.

Int. 67. Do I understand that your last answer applies in all its statements to the valves made by the complainants during the period from that time on?

Ans. That is the import of my answer.

. . . . . .

Nov. 4, 1886.

Cross-Int. 173. In answer to Ints. 29, 30 and 31, you pointed out what you were pleased to consider defects in the Richardson valve and advantages in the Crosby valve: do you mean by all that which you have said in answer to those three questions, that it is now, or ever was, your judgment or recollection that a valve which was flat-seated, spring loaded, and which was not either an adjustable pop valve or a pop valve at all, but whose spring was encased, was preferable or preferred to a pop valve or an adjustable pop valve with a bevelled seat, spring loaded, whose spring was not encased?

Ans. It is now my judgment, and ever has been since meeting an unencased valve with the peculiarities described in the question, and having to offer against it an encased valve with flat seats as described, that the advantages of the latter so far transcended the former that it became possible, with a wide difference in price as a strong element to meet, to sell the encased valve, it being, as a rule, fully two thirds higher in price, and I consider that, by the advantages thus set forth in the encased valve, I was enabled to sell the Crosby valve as generally as I did.

Cross-Int. 174. Did you ever sell any safety valves which were not pop valves?

Ans. I don't remember that I ever did.

Cross-Int. 175. I am to understand, then, that you consider the encasing of the spring without a pop action to the valve to be of more importance commercially than the pop action?

Ans. I would not make that which refers to my testimony in regard to an encased spring general, for the following reasons: Many valves are placed inside of buildings where there is practically constant temperature. To such this would not apply. But specifically I would say that I did consider, at the time of introducing the pop valve to the farm-engine trade, that the form of a valve which included among other useful devices an encased spring was more to the advantage commercially as applied to this particular line of cases than the pop principle, as the common valve did and would perform the offices of safety on farm engines, as the size of the valve ordinarily used was the size that was afterwards used in

the pop valve, therefore practically throwing away the advantages which the pop valve yields in being more efficient and disposing of excess steam more promptly.

TENTH ERROR.

Upon the question of interest to be allowed on the judgment entered under the decree of the Court below, the appellants requested that it should run only from the date of the decree, to wit, Oct. 11, 1890. Their request was overruled, and the time when interest should begin was determined to be as of the date of the filing of the master's report, to wit, Aug. 5, 1889; and so the decree declares. (See Record, page 351.)

In this it errs.

The record shows that the master's report was filed at the May term, 1889, to wit, Aug. 5, 1889; the case was submitted to the Court below at the October term, 1889, and thence continued under advisement to the October term, 1890, when the opinion of the Court was rendered, to wit, on Oct. 7, 1890. Oct. 11, 1890, the decree was entered. (Record, pages 350 and 351.)

The rule of this court relative to interest in a case like this is so well stated in *Mowry* v. *Whitney*, 14 Wall. 620, 653, that it is given here at length.

In this case, the master found interest on the profits to the date of his original report, Aug. 1, 1868. The Circuit Court confirmed this finding, and decreed interest also from Aug 1, 1868, to the date of the final decree, Aug. 1, 1870. This Court disallowed both items of interest.

It said, in its opinion: —

"The defendant should not have been charged with interest before the final decree. The profits which are recoverable against an infringer of a patent are, in fact, a compensation for the injury the patentee has sustained from the invasion of his right. They are the measure of his damages. Though called profits, they are really damages, and unliquidated until the decree is made.(1) Interest is

(1) In Locomotive Safety Truck Co. *v.* P. R. Co., 2 Fed. Rep. 677, Mr. *Justice* STRONG said: "It is doubtless the general rule that interest prior to the final decree is not to be allowed upon profits or damages, because, until the decree, they are unliquidated," citing Mowry *v.* Whitney, *supra*.

not generally allowable upon unliquidated damages. We will not say that in no possible case can interest be allowed. It is enough that the case in hand does not justify such an allowance. The defendant manufactured the wheels of which the complaint is made under a patent granted to him in 1861. His infringement of the complainants' patent was not wanton. He had before him the judgment of the Patent Office that his process was not an invasion of the patent granted to the complainant, and though this does not protect him against responsibility for damages, it ought to relieve him from liability to interest on profits."

This case followed the earlier case of Silsby *v.* Foote, 20 How. 378 (1857).

In Littlefield *v.* Perry, 21 Wall. 205, 218, this rule was approved.

Later cases are of the same view.

Parks *v.* Booth, 102 U. S. 96, 106.
Illinois Central R. R. *v.* Turrill, 110 U. S. 301, 303.
Tilghman *v.* Proctor, 125 U. S. 136, 160.

Whatever there may be in the two last cases regarding the date when interest begins which seems to depart from the general rule so established in *Mowry* v. *Whitney*, *supra*, is due to the peculiar circumstances of these cases.

In the case of *Illinois Cent. R. R.* v. *Turrill*, *supra*, the contention arose from these facts: —

July, 1874, the original decrees charged the appellants with profits.

These decrees were affirmed in 1876, and the cases only sent back to ascertain how much should be deducted from those decrees for errors in the accounts then stated.

In 1879, the master reported, and interest was charged from the date of the master's report.

The appellants assigned this as an error.

Upon these facts this Court say: —

"Under these circumstances, it seems to us not at all inequitable to allow interest on the corrected amounts from the date of the master's report in 1879. The cases are entirely different in this particular from what they would have been if the original decrees had

been reversed for error in the principles of the accounting. Those decrees may very properly be considered as affirmed in part and reversed in part, the new reference being had only to find out the exact extent of the reversals."

Had the original decrees been reversed, as stated, then there would have been proper ground for error, is the clearly intimated view of the Court.

The later case of *Tilghman* v. *Proctor*, *supra*, followed the preceding case.

In this case the Court say: —

"The only exception of any importance, not disposed of or rendered immaterial by what has been already said, is the exception of the plaintiff to the refusal of the master to allow interest on profits before the date of his report."

In this case interest was allowed from the day the master's report was submitted to the Court.

Commenting upon the established rule, Mr. *Justice* GRAY, speaking for the Court, said: —

"The profits allowed in equity, for the injury that a patentee has sustained by the infringement of his patent, have been considered as a measure of unliquidated damages, which, as a general rule, and in the absence of special circumstances, do not bear interest until after their amount has been judicially ascertained."

In the case at bar the appellants are no more wanton infringers than the Court found the defendants were in *Mowry* v. *Whitney*. Here the appellants made and sold the Crosby valve under the protection of the Crosby patents, and still more under the supposed protection of the decision of the Circuit Court that this valve did not infringe the Richardson patent.

The period of the accounting between the parties was from Feb. 15, 1879, to Sept. 25, 1883.

This case was begun May 27, 1879, and the opinion therein of the Court below was announced April 30, 1881. Excepting a few days prior to the filing of the bill of complaint the time of infringement by the appellants, for which the master found the enormous sum for profits made by them during this interval, the appellants

were in a serious controversy as to the validity of the Richardson patent and the charge of its infringement by them, both in the Court below which gave them judgment and afterwards in this Court.

It cannot be said that they should be charged with interest on these profits until it was judicially determined that they were due to the complainants (appellees). This could not be until the date of the decree, Oct. 11, 1890, if this Court shall find there was no error in the master's report in ascertaining such profits.

Indeed, in applying the principle of *Mowry* v. *Whitney*, the history of their defence shows that, while it may not "protect them against responsibility for damages, it ought to relieve them from liability to interest on profits."

EDMUND WETMORE,
JOSHUA H. MILLETT,
Counsel for Appellants.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1891.

No. 999.

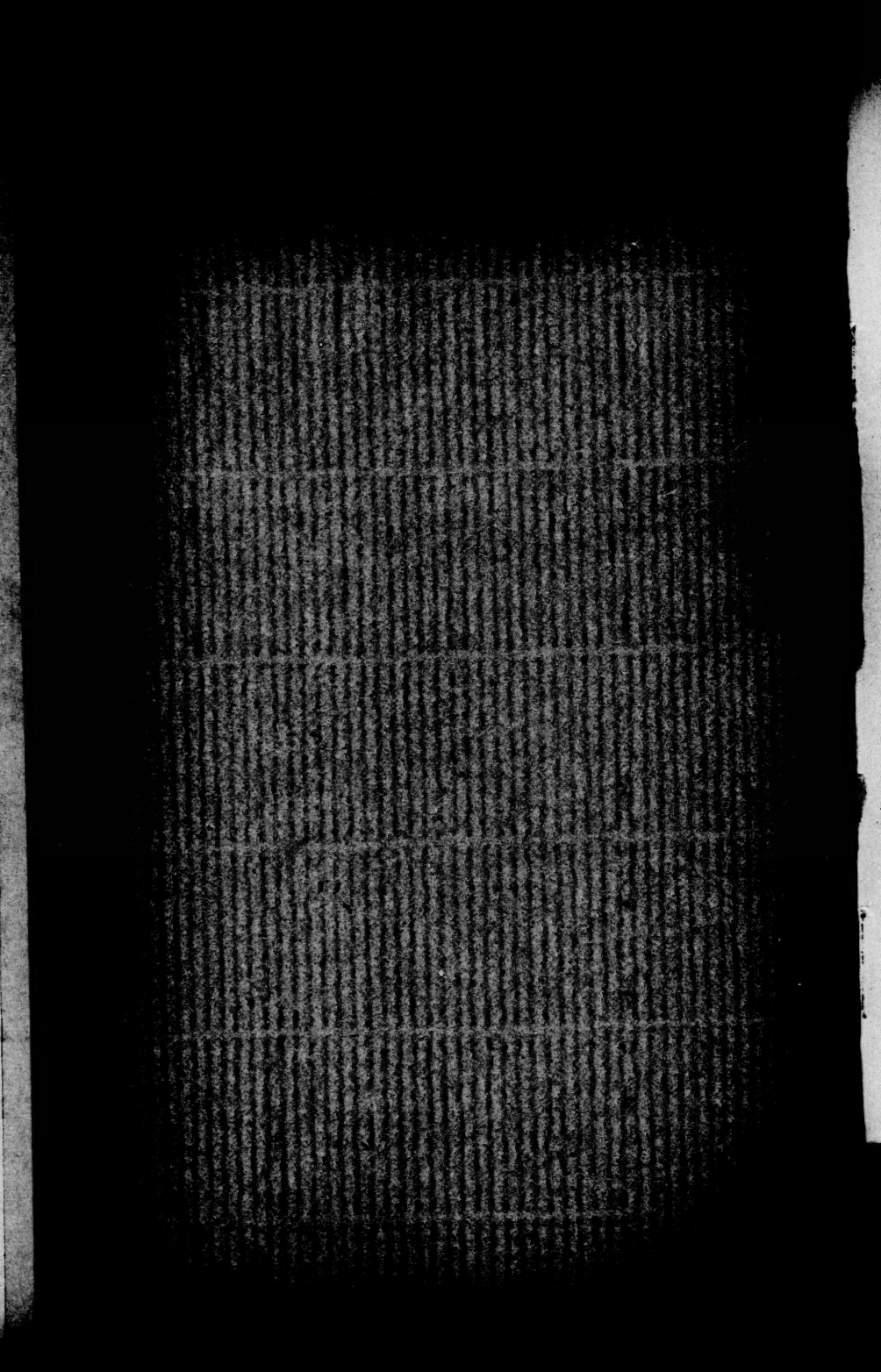
THE CROSBY STEAM GAUGE AND VALVE COMPANY,
Appellant and Defendant,

vs.

THE CONSOLIDATED SAFETY VALVE COMPANY,
Appellee and Complainant.

SUPPLEMENTAL BRIEF FOR APPELLANT.

EDMUND WETMORE,
J. H. WILLET,
Of Counsel for Appellant.



Supreme Court of the United States.

OCTOBER TERM, 1891.

THE CROSBY STEAM GAGE AND VALVE COMPANY, Appellant, vs. THE CONSOLIDATED SAFETY VALVE COMPANY.	No. 999.

Supplement to Brief for Appellant.

For convenience the following brief summary of the points upon which appellant relies, and which are more fully discussed in the main brief, is herewith presented.

Facts.

The Richardson patent for the infringement of which this suit was brought, is for an improvement in steam safety valves, which consists "in increasing "the area of the head of the common safety-valve "outside of its ground joint and terminating it in "such a way as to form an increasing resist- "ing surface against which the steam escaping "from the generator shall act with additional "force after it has lifted the valve from its

" seat at the ground joint, and so by overcom-
" ing the rapidly increasing resistance of the spring
" or scales, insure the lifting of the valve still higher,
" thus affording so certain and free a passage for the
" steam to escape as effectually to prevent the
" bursting of the boiler or generator, even when the
" steam is shut off and the damper left open."

The further description of the device in the specification shows (referring to Fig. 3 of the drawing) an extension and overhang *(c)* at the top of the valve, extending over the edge of the rim of the valve seat (E) and there loosely fitting, like a loosely-fitting box cover and forming an annular chamber D, which has been called, in this case, the huddling chamber. When the valve is lifted by increase of pressure in the boiler the steam rushes through the ground joint F into this chamber, and, as the steam enters through said ground joint faster than it escapes through the outlet at the rim, it exerts a pressure in the said chamber which tends to lift the valve still higher, and will hold it up until enough steam has escaped through the outlet to lower the boiler pressure, and consequently both the pressure beneath the valve and in the chamber, sufficiently to enable the spring which rests on top of the valve to close it.

The intended utility of the device was to ensure a wide, free opening when the steam in the boiler rose above a given pressure, and the prompt closing of the value when proper relief had been given, without too much loss of steam.

This Court, in construing this patent for the purpose of determining the question of infringement, held that, " in the Richardson valve, all the steam which escapes
" into the open air escapes from the huddling cham-
" ber, through a stricture which is *smaller than the*
" *aperture at the ground joint.*"

113 U. S., p. 178.

And quotes Richardson's own description of this device in a later patent relating to an improvement upon it, as follows:

"When the pressure of the steam lifts the valve, the "steam acts against the surface of an annular space "between the bevel of the valve seat and the down-"ward projecting flange of the cap plate to assist in "holding up the valve against the increasing resistance "of the spring. The aperture between the valve and its "seat *is always greater* than that between the flange and "the upward projecting rim, and thus the steam in the "annular space assists in holding up the valve till the "boiler pressure falls below that at which the valve "opened" (italics not in original).

This construction of the patent received subsequent corroboration from the decision in the case of the *Consolidated Safety Valve Company* (the appellee herein) *vs. Kunkel*, wherein Judge BLODGETT'S decision in the Court below was affirmed in this Court.

The suit involved the Richardson patent in controversy in the present case, and Judge BLODGETT held that the said patent required "that the space for the "escape of the steam between the flange and ring "encircling the expanded valve head shall be of "*less* area than the area of escape at the valve "seat" (italics added), and he held that, although the defendant's valve in that case, the Kunkel valve, showed "an extended area of the "valve-head, so that the steam, as it escapes through "the ground joint, impinges upon the flange of the "valve-head, and by its impact furnishes an auxiliary "lift to aid in raising the valve still higher," and although "the steam may be to some extent huddled, or "compelled to exert its expansive force on the under "side of the extended area of the valve-head by means "of the crooked or angular passages through which it "makes its exit to the open air," yet, that it did not contain the Richardson strictured outlet, defined as

above to be an outlet of smaller area than the outlet at the ground joint, and, therefore, did not infringe.

In affirming this decision, this Court says that the Kunkle valves "have no huddling chamber, and no "strictured orifice leading from a huddling chamber to "the open air," which, in view of the record in the Kunkle case and the opinion of the Court below, and the prior opinion herein, is understood to mean that the Kunkle valves have no huddling chamber, such as is shown in the Richardson patent, *i. e.*, one which acts as an auxiliary lifter by reason of the strictured orifice opening into the outer air, and smaller in area than the orifice through which the steam enters.

The appellants' valve, in this case, known as the Crosby valve and made in accordance with the Crosby patents, is so constructed that it has two ground joints. When the valve rises by reason of increased pressure, part of the steam escapes through one ground joint directly into the open air, and part of the steam escapes through the other ground joint into a huddling chamber, and thence into the air through orifices which form an aperture less than the ground joint orifice through which it enters said huddling chamber. Although the relief to the boiler caused by the blowing off of the valve was in consequence of this double mode of escape for the steam, due to the combined effect of its escape through the huddling chamber and its escape through the second ground joint, yet, as all that part of the steam which entered the huddling chamber passed through the strictured opening, the Court held that the valve contained the Richardson device, and was, therefore, an infringement.

In 1869 Richardson obtained a second patent for an improvement on the structure above described, consisting substantially of the addition thereto of a certain adjustable ring for regulating the escape of steam, and

brought a separate suit against the appellee herein for its infringement.

Appeals in both suits were heard at the same time in this Court, and the patent in the second suit was also sustained, and the appellant's valves held to be an infringement thereof, as well as of the first patent.

Under the mandates issued to the Court below, upon these decisions, both suits were referred to the same Master under the usual decrees to report the profits and damages due to each infringement.

The periods covered by the accountings in the two suits were, respectively, as follows:

In the first suit, in which this appeal is taken, the accounting extends from February 15th, 1879, when the appellees obtained title to the patent, to September 25th, 1883, when it expired.

In the second suit, the accounting extended from the same date, February 15th, 1879, when the appellees also obtained title to the second patent, to January 31st, 1885, the date of the injunction in said suit.

It will be observed that for the first period named the appellants were liable for the infringement of both patents, and from September 25th, 1883, the end of that period to January 31st, 1885, the end of the second period they were only liable for the infringement of the second, or 1869 patent.

The testimony before the Master was, briefly, as follows:

1. The complainants (appellees) through the defendants' (appellants') officers and by means of its books, proved the entire net profits of its business of making and selling valves during the whole period covered by the accounting in both suits.

2. The complainants offered no evidence before the Master as to the pecuniary value of the invention of the first patent, as construed by the Court, in the defend-

ants' valves, or as to the proportion of the profits derived from the sale of those valves due to the fact that they contained the said invention.

3. As to the value of the second invention, the complainants called their business manager and salesman, who testified as follows:

"Int 10. In making sales prior to September 25, "1883, was the adjustable feature of the safety valve "which involved the use of a screw ring insisted upon "as matter of importance either by the Consolidated "Safety Valve Company" (the appellee) "or by the "Crosby Steam Gage and Valve Company" (the appellant)?

"Ans. The Consolidated Safety Valve Company did "lay great stress upon the adjustable feature of their "safety valves by means of a screw ring, and with the "users of safety valves that feature was considered so "valuable that we were required to furnish the adjust-"able screw-ring with all safety valves, and, from my "experience in the manufacture and sale of safety "valves, I am confident that it would have *been almost* "*impossible to have sold our safety valves* without the "adjustable screw-ring to a majority of users of spring-"loaded safety valves. In regard to the prominence "given to the adjustable screw-ring by the Crosby "Steam Gauge and Valve Company, I have in my pos-"session catalogues issued by them and advertisements "placed in the mechanical journals of the country, and "in each and all of them the adjustable feature is set "forth in very prominent type and universally re-"ferred to." (Italics ours.)

Rec., p. 160.

And further testimony was given by the same witness as to the convenience and value, in general, of the adjustable ring and the practical necessity of its use in the Richardson valve in order to make the latter sala-

ble. Upon this latter point the witness testified as follows:

"Int. 59. Did you at any time since you have been "engaged in selling pop safety valves manufacture "or offer to manufacture for customers non- "adjustable valves, that is to say, valves not "furnished with a means of adjusting the re- "lation between the opening and closing "pressure, or, in other words, of regulating the reduc- "tion of pressure, and, if so, at what time, at what "comparative prices as regarded prices of the adjust- "able valve, and what was the extent of the demand "for such valves?"

"A. We did manufacture a locomotive valve, "which we termed the *old style Richardson*" (italics ours. Note this is the valve of the patent involved in this accounting without the addition of the invention of the second patent), "and did offer it a price "ranging from ten per cent. to twenty-five per cent. "below our prices for the locomotive valve with the "adjustable ring, but our customers preferred to "use the adjustable ring to such an extent that "we discontinued the manufacture of them. We also "made a valve, which we termed the Richardson valve, "for stationary and marine work without the adjust- "able ring, *and had no sale for them*" (italics ours), "and "did not complete the full line of patents" (patterns?) "and I do not think we sold twenty-five of that type "of valves. The demand for the locomotive valve with- "out the adjustable ring was so limited that we did "not even make a cut of it or publish it in our "catalogue."

(Rec., p. 172.)

4. The complainants having rested, the defendant called their salesman, F. T. Simmons, who testified that he had been in the company's employ in that capacity from February, 1878, until May, 1886, and traveled

over nearly the whole United States, and was familiar with the safety valves then and since in the market. That from the year 1879, the date when the accounting begins, there were in the market, besides the Richardson and the Crosby valves, the Kunkle valve and a large number of others (and it is to be noted that Moore, the complainant's salesman, testifies that he was obliged to lower the price of the consolidated (Richardson) valve, because of the competition of the Kunkle valve, which was specifically held no infringement of the Richardson, and there is no proof made on the part of complainants herein that any of these competing valves were infringements (Rec., p. 165). He testifies at length as to the peculiarities which gave the Crosby valve its commercial success over others, *viz.*, its size, portability, ease of application, durability, its reliability, its peculiar adaptability to farm engines, its use of a flat instead of a beveled valve, and its practical superiority proved in trial tests over the Consolidated (Richardson) valve, sold by the complainants.

Rec., pp. 184 to 195; Cross-Int., 173, p. 201.

5. Mr. Eager, the defendant's treasurer, testified that so far as the Crosby valve was concerned, the removal of the adjustable feature had no effect upon its sales, and that, in that valve, the adjustable feature was not generally used by its customers.

Rec., p. 208.

6. The defendant then called as witnesses, Messrs. Hoadley and Harrison and Burnett, and proved by a series of accurate measurements and carefully conducted experiments:

FIRST. That a valve made in the required proportions of the Richardson patent of 1886, here in controversy,

and in precise accordance with the drawings and description, *without* the improvement of 1869, and with the area of escape at the outlet *smaller* than the area of entrance at the ground joint, was not as economical, or as good, in action, as the earlier Webster valve.

SECOND. That a Richardson valve constructed in this manner in precise accordance with the patent of 1866, was not an economical valve at all, but operated with a large loss of steam averaging upwards of twenty-seven per cent., while a good commercial valve should not lose over from three to five per cent.

THIRD. That all the valves now sold by the complainants as Richardson valves, and identified as such by Mr. Richardson himself, who was called by the complainants for that purpose, being the same in pattern as those sold by them since they began business, are not constructed so that the area of escape from the huddling chamber is *smaller* than the area of entrance from the ground joint, but *larger*, being, as shown by the tabulated statement of the defendant's witnesses, about *twice* as large. The evidence tends to show that the complainants have never put a valve upon the market with the orifice of escape from the huddling chamber *smaller* than the orifice of entrance to the huddling chamber.

Rec. pp. 213, 214 *et seq.*, 228 *et seq.*, 363 *et seq.*, and table p. 266; Richardson's Testimony, pp. 224 *et seq.*

7. The defendants then called Mr. Crosby, the inventor and patentee of the Crosby valves, and superintendent of the defendant's works. He testified that without the Crosby invention, whereby the double outlet is afforded for the steam, the valve would be substantially worthless as a safety valve. He says, speaking of the Crosby valve held to be an infringement and included in the

accounting, "Such a valve, unless it had a large outlet, "independent of the parts named in the question," (*viz.*, the huddling chamber and small outlet) "through which "the steam from a boiler to which it might be attached "could freely pass to give relief to the boiler, would "be substantially worthless as a safety valve, although "it might be an operative one; but the Crosby valve has "such an outlet, at the outer circumference of the "initial area when the valve rises to blow, which is "unobstructed and free to allow the steam to go into "the open air and relieve the boiler by reducing the "pressure from two to more pounds, as may be desired. "The Crosby valve, thus made, is a prudent one in its "operations."

Rec. pp. 281, 282.

In answer to defendants' testimony, the complainants called Mr. Forbes, who,

1. Confirmed the testimony of defendants' witnesses as to the operation of the Richardson valves, made, as testified to by said witnesses, in precise accordance with the drawings and description of the Richardson 1886 patent, but disputed the accuracy with which said valves followed said drawings. He produced valves differing in some of their dimensions from those produced by defendants, and stated that they worked economically, but in each of these valves the area of escape is *larger* than the area of entrance through the ground joint. Messrs. Harrison and Burnet examined these valves, entitled respectively, "Complainant's Exhibit True Representation Richardson Valve from Original Drawing of 1866," and "Complainant's Exhibit Forbes Exhibit Corrected Representation Richardson Valve Photo-lithograph Drawing," and testified without contradiction that they did not conform to the requirement of the patent; that the area of escape shall be less than the area of entrance.

Mr. Harrison says: "Int. 209. In what respect does "the exhibit" (Forbes's Representation) "differ from "the valve described in the patent?"

"A. It differs from the fact that it has a witdh of "outlet nearly double that shown in the patent, and "an overlap only two-thirds of that shown in the "patent.

"210 Int. Do these differences materially change it "from the valve described in the patent; and if so, "why?

"A. They do materially change it; they materially "change the action of the valve, causing it to take out "very much less steam from the boiler than a valve "would do if made strictly to the patent.

"211 Int. Why is there less loss of steam in oper-"ation?

"Ans. Because the valve of the Complainants' Ex-"hibit True Representation Richardson Valve from "Original Drawing of 1866 *at all times* has a *larger* "area of opening from the circumferential chamber to "the atmosphere than the area of the opening at the "ground joint leading into the circumferential cham-"bers." (Italics ours.)

* * * * * *

"Int. 217. How do these dimensions in the exhibit" (*viz.*, the other valve produced by Forbes marked "Complainauants' Exhibit Forbes Exhibit Corrected Representation Richardson Valve Photo-lithograph Drawing) "change the opening at the ground joint and "at the lip from those which you have found to exist "in the defendants' valve made like the drawing?

"Ans. In the complainants' valve the area of the "outlet from the circumferential chamber is always "larger than the area of opening at the ground joint, "and, in a valve made according to the drawing, the "area of the outlet from the circumferential chamber "will be less than the area of the opening at the ground "joint into that circumferential chamber."

Rec., pp. 314 *et seq.*; pp. 320, 321.

And Mr. Burnett fully confirms this evidence.
Rec., pp. 328, 329.

In other words, the complainant introduces no evidence to disprove the fact as to the uneconomical working of the Richardson valve of the 1886 patent, if made in accordance with Richardson's own definition quoted in the opinion of this Court, *viz.*, so as to have "a narrow escape for the steam when the valve is opened, "but which, although of greater diameter than the "valve-seat, by reason of the said lap, presents a *less* "area of opening for the escape of steam than is produced at the valve-seat," but alleges that if this part of the description be ignored, the drawing justifies a construction just the opposite of this, *viz.*, one in which the outlet for the escape of the steam presents a *greater*, a much greater, a nearly *doubly* greater, area of opening than is produced at the valve-seat.

2. Mr. Forbes also disputed the accuracy of the conformity of the Webster valves produced by the defendants to the drawings of that patent, and did not agree with them as to the economical action of the valve.

The foregoing is a summary of all the material evidence before the Master.

Upon that he found and reported:

1. That the complainants' valves shown, as above stated, by uncontradicted evidence, to have a larger area of steam escape than of entrance at the valve seat, contained the Richardson invention of the patent in suit.

2. That the whole profit derived by the appellant from the manufacture and sale of the Crosby valves during the period covered by the accounting in the first suit, *viz.*, from February 15th, 1879, to September 23d,

40,344.59

1883, amounting to ~~$42,741.47~~ was due to the presence in those valves of the Richardson invention of the patent of 1886, and that the complainants were, therefore, entitled to recover in said suit the whole of said profits.

3. And he found as to the second or 1869 Richardson patent (the accounting in which it will be remembered embraced the whole of the above period and more), as follows:

"I have heretofore determined the profits which the "defendants made from their valve business from "February 15, 1879, to January 31, 1885, but I am un- "able to determine from the evidence before me, what "portion of these profits, if any, is attributable to the "Richardson invention of 1869, declared on in the "second case before me."

Rec., p. 16.

In explanation to these last two findings, the Master, in effect, argues that, while he has no means of determining the value of the 1869 invention in dollars and cents, yet since the complainants would be entitled to recover that value, whatever it may be, in the second suit, if it could be proved, no harm can come from permitting them to recover the whole profits from the defendants in the first suit, even though an undeterminable portion of those profits are only, as matter of law, recoverable in the second suit.

Rec., p. 15.

The Master's report, findings and rulings were duly excepted to by the appellant at every stage; the exceptions were overruled by the Court below, and the Master's report in every respect confirmed; and from the decree of the Court, entered in conformity therewith, this appeal is taken.

POINTS.

The exceptions raise for determination the main contention of the appellant, which is, in brief, that there was no evidence before the Master to justify the finding that the whole profits derived from the manufacture and sale of the Crosby valves was solely due to the presence in those valves of the Richardson invention of 1866; that those valves contained valuable patented improvements not embraced in the accounting herein, and the complainants, under an established rule of law, were in such case obliged to furnish some definite and satisfactory evidence of the value of the particular improvement involved in this suit, as distinguished from the other inventions and mechanical improvements contained in the valve and contributing to its commercial value, which the complainants wholly failed to do, and by reason of this failure the decree should have been for only a nominal amount.

The reasons which the appellant urges in support of this contention are, briefly, as follows:

First.

The Master had no right to consider any issue before him without keeping in view of the fact that the Richardson invention of 1866 involves, as a necessary feature, that the area of the outlet from the huddling chamber shall be *less* than the area of entrance thereto through the steam joint. No evidence of value derived from any valve not having that feature is admissible or relevant. So far as this accounting is concerned, that

point is fixed. If the Richardson patent of 1866 can be construed without that limitation the Court has not done so in this suit, and the Master cannot expand or depart from the definition of the invention adopted by the Court. The appellant is charged with infringement because, and solely because, the area of escape from the huddling chamber in the Crosby valve, as made, was smaller than the area of entrance. If the patent can be made to cover a construction in which this feature is omitted it may be made the ground for another suit for infringement, or for a motion for a rehearing. Under this decree, and for the purposes of this accounting, the feature in question is absolutely essential in any consideration of the invention.

Nor could the Court find otherwise, for that feature is the *only* feature which the Crosby valve has in common with the Richardson patent of 1866 that it does not have in common with prior valves, the Webster and others. The Crosby valve is not like the Richardson valve of 1886, except in the said respect of the relative size of the inlet and outlet openings of the huddling chamber either in the number, kind, location, shape or proportion of its parts any more, nor so much as it is like the Webster valve. The only feature it has borrowed from the Richardson patent of 1866 is that single ratio of proportion. Eliminate that and it would be impossible to find infringement.

Counsel in taking this position has not lost sight of certain passages in the opinion of the Court, where Richardson's invention is described without the express statement that the ratio between the opening at the valve seat and the escape orifice, above mentioned, is an essential feature of that invention; as for instance, the passage where it is stated that "Richardson is therefore "entitled to cover, by the claim of his patent of 1866, "* * * a valve in which are combined an initial "area, an additional area, a huddling chamber beneath "the additional area, and a strictured orifice leading from

" the huddling chamber to the open air, the orifice being " proportioned to the strength of the spring, as di- " rected. The direction given in the patent is, that " the flange or lip is to be separated from the valve " seat by about $\frac{1}{64}$th of an inch for an ordinary spring, " with less space for a strong spring and more space " for a weak spring, to regulate the escape of the " steam, as required "(113 U. S., pp. 176, 177).

But, in view of the other parts of the opinion, which, as an accurate description of the invention quotes Richardson's own description thereof, in his patent of 1869, in which he states, " that the " aperture between the valve and its seat " is *always* greater than than between the flange and " the upward projecting rim ;" and in view of the fact that the Court repeats this statement in comparing the Crosby valve with Richardson's in discussing the question of infringement, no other interpretation of the whole opinion than the one here insisted upon seems possible. The width of the opening of the escape orifice, stated by Richardson to be 1/64th of an inch for an ordinary spring, makes an opening of less area than the ground joint, as is shown by the testimony of the appellants' witnesses on the accounting, and if the limitation of this difference in ratio between the ground joint opening and the escape orifice opening be abandoned, not only must Richardson's express declaration that the feature is always to be found in his invention, be disregarded, but, as already stated, no rule is given by which Richardson's invention can be distinguished from prior structures or any rule laid down by which infringement can be determined. It is not understood that this Court construed the patent so that it can cover *any* valve in which there is an initial area, an additional area, a huddling chamber, having an escape orifice which may be larger than the entrance thereto from

the ground joint, provided all the parts ars so proportioned that the valve operates to give sufficient relief, and close after a small loss of steam. That result depends upon the proportion of the various parts, and Richardson furnishes no rule of proportion to meet such a case.

Second.

There was no evidence whatever before the Master that this ratio of proportion between the inlet and outlet of the huddling chamber was, as a separate device, as shown and covered by the patent of 1866, and without combination with other devices, of any value whatever; on the contrary, the uncontradicted evidence was, and the fact is, that, by itself, it is disadvantageous, rather than valuable.

The evidence as to commercial success in the main case, with the exception of a single witness, all related to a period subsequent to 1869, after the improvement of the second patent was added, and, upon the complainants' own testimony before the Master in this case, the Richardson valves, after the addition of said improvement, were practically unsalable without it.

It appears, without contradiction, that the Richardson valves which the complainants are now selling, and, apparently, all they have ever sold, do not have this ratio of proportion, but directly the reverse, and that a valve made with this ratio of proportion, and like the Richardson 1866 patent, pure and simple, is so uneconomical as to be commercially worthless.

The Crosby valve, held to be an infringement, was made in accordance with the Crosby patent, which states that the outlet from the huddling chamber is "*prefera-*

bly" of smaller area than that of the opening of the ground joint leading into the same, and not a particle of evidence was offered by the complainant to show that this statement was false, and that the ratio of area stated was not a preferred, but an essential feature of the defendants' structure, or what pecuniary profit it received from adopting that ratio of proportion, over adopting the opposite ratio of proportion which it was free to use, and employing an outlet from the huddling chamber, as in the Richardson valves of commerce, which was larger than the inlet thereto. To say, *first*, that this feature was essential to the Crosby valve, and *secondly* that the *whole* profit of the valve was due thereto, is pure conjecture. There is not a scintilla of evidence to sustain such a conclusion.

Third.

The only answer to the above which has hitherto been made by the appellee, and the view which was taken both by the Master and the Court below, is, in effect, that the defendants are estopped by the record from proving the above recited facts.

The position of the appellee, in other words, amounts to this. So far as profits are concerned, every possible question which could arise in the accounting before the Master, except the bare question as to the total amount of profit derived by the defendants from the sale of the Crosby valve—was foreclosed and decided by the decree of this Court. That decree determined conclusively against the defendant, not only that the Richardson patent of 1866 was a valid patent and had been infringed, but, also, that every penny

of profit which the defendant might have made by making and selling the Crosby valve, during the period covered by the infringement, was derived from the Richardson invention of 1866, and nothing else. That the Court found that invention to be of such a fundamental character that, as a necessary consequence, the whole commercial value of any valve containing the patented feature was due thereto, and that the defendants were estopped, and evidence could not be introduced before the Master tending to show that its commercial value was any different or less. That all the complainant had to do before the Master was to present the decree of this Court and demand the defendants' whole profits, and the Master was bound to allow them.

Counsel for appellant contests this position, and insists that the effect of the decision of the Court upon which the interlocutory decree herein was based, does not extend so far.

The only issues heard and determined by the Court in granting the interlocutory decree were, in this case, the validity of the patent, and its infringement. The amount of profit made by the defendant by reason of that infringement was not an issue considered by the Court. The pecuniary value of the invention was not an issue. As incidental to the decison of the issue whether the patent had been anticipated, or whether it disclosed a patentable invention, the circumstance of the commercial success of articles made under the patent was a pertinent fact, and the Court would properly consider the evidence bearing thereon, but that, it is submitted, did not involve as a necessary result, that the conclusion to which the Court might come, as to the fact disclosed by that evidence in determining the issue of patentability, prevented the defendant from showing additional facts, or even a different state of facts where the sole issue involved was the pecuniary profit actually derived from the invention.

The evidence in the main case, referring to the Richardson valves of commerce, was, doubtless, assumed by both parties to relate to a valve having the feature of a strictured escape orifice in the huddling chamber, less in area than the area of entrance at the ground joint, and on that assumption it was treated by the Court. It now appears that this was erroneous, and that such was not the construction of the Richardson commercial valves.

But that error does not prove that the Richardson patent was invalid or affect the question of infringement. It bears only upon the question of value, and simply corrects a wrong assumption. It does not contradict any positive evidence. If the main case were opened and this evidence introduced, it might modify the views of the Court as to the importance of Richardson's invention, as he chose to define it, but it would by no means involve a different conclusion as to its patentable novelty. In accepting and considering this evidence, therefore, neither the Master, nor the Court below are disregarding any issue settled by the interlocutory decree.

Fourth.

The invention of the 1869 patent was, if not an essential, an important element of the commercial value of the Richardson valve. The complainants proved that after its introduction the commercial success of the Richardson valve was absolutely dependant upon its use. The Court, in the main case, distinctly recognizes its importance as an element contributing to the success of the valve. In comparing the Webster valve with the Richardson, one of the reasons given

for discarding Webster is its inferiority in this respect. The Court says:

"Webster's patent describes a means of making the "area for the escape of steam adjustable, consisting of "adjusting up and down on a smooth valve stem, a "sliding collar or flange and fixing it in place by a set "screw; but it does not show the screw-ring of Rich- "ardson with its minute delicacy of adjustment and "action," and speaking of what Richardson accomp- "lished, and the apparatus by which he accomplished it, the Court says: "His patent of 1869, describes "the arrangement and operation of the whole "apparatus with the adjustable ring, thus;" and then proceeds to quote the description. That is to say, the opinion of the Court in the main case, did not attribute the whole value of Richardson's valve to the patent of 1866 alone, but to the two inventions together, and, therefore, that decision does not justify the inference of the Master, confirmed by the Court below, that the whole value of the Crosby valve was thereby conclusively determined to consist in the fact that it employed the said invention of 1866, as one of the elements of its construction,

It is no answer to this that the defendant introduced evidence to show that the adjustable ring was not essential to the salable value of the Crosby valve, as was proved by the fact that the omission of that ring did not affect its sales. That circumstance merely proved that the Crosby value could dispense with the adjustable ring while the Richardson valve could not. The point here made is that if *part* of the value only of the complete Richardson valve was due to the patent of 1866, and if it is proved that a valve having the invention of the patent of 1866, pure and simple, has very little salable value—then those facts alone not only do not justify but preclude the conclusion that the *whole* value of the Crosby valve, which contained the Richardson invention of 1866,

plus the invention of 1869, plus the Crosby invention, was due to the said Richardson 1866 invention alone. If the Crosby valve could dispense with the 1869 invention without affecting its salable value, that only goes to prove that owing to the precision and perfection of its operation due to the presence therein of the Crosby invention, or other peculiarities of its structure, it was salable without the adjustable ring, while the Richardson valve was not.

Because Crosby could dispense with that ring, it does not follow that Richardson could do so, especially in the face of the complainants' own testimony to the contrary.

Therefore, the conclusion of the Master and the Court below, that the Richardson invention of 1866 was the whole life and soul of the Crosby, derived as it was solely from the opinion of this Court in the main case, and not from any evidence either in the main case or before the Master, was a conclusion which there is nothing to justify.

Fifth.

The life and soul of the Crosby valve was the Crosby invention. That invention consisted principally in an addition to the valve of a second ground joint opening directly into the open air. The opinion of the Court in the main case states that this circumstance causes a difference "only of degree, but with the same mode of operation" as Richardson's. By degree here is not meant that the Crosby valve contains the Richardson invention, but with the ground joint orifice, or the escape orifice, a little larger or smaller than Richardson's—while still maintaining the required ratio between them—but it apparently refers to the fact that

the lift and fall of the valve is, in part, affected by the steam that passes through the huddling chamber and through the narrow outlet, and, in part, by the steam that escapes through the second ground joint, for, it would seem, that only in this sense can the difference between accomplishing the result by Richardson's device combined with an additional outlet, and accomplishing that result by Richardson's device alone, be termed a difference of degree. But that difference in the Crosby valve is a vital one. It is a difference involving a mode of construction and operation for which patents have been granted, and there is no evidence or suggestion in this case that those patents are invalid or did not involve invention. They involved invention of a high order. The conception that a double escape for the steam would accomplish the desired result was original and novel. The useful effect it produced could not only not be predicted, but was contrary to what might have been expected.

The essence and gist of the Richardson theory is to send the whole body of steam through a closely throttled passage, and thus obtain a high lifting power. Upon the theory of that patent a simultaneous free opening for the steam would be fatal to its effectiveness. That the Crosby valve should operate, as it undoubtedly does, and both open freely and close after only a small loss of steam, is the result of a discovery. The Crosby valve is as much a departure from the valves that preceded it, including Richardson's, as Richardson's valve was a departure from the valves that preceded it.

The fact is proved before the Master by positive testimony that without the Crosby invention the Crosby valve would be useless and commercially valueless. This testimony is in harmony with the inherent character of the Crosby device. What right had the Master to disregard it? Suppose the Crosby valve

had been made just as it is, without the sanction of the owner of the Crosby patent, and that owner had sued the maker of the valve and recovered. Would he have been entitled to recover none of the profits of selling the valve? If either patentee would, in the case supposed, be entitled to recover the whole profits, it would be Crosby rather than Richardson.

The familiar rule of law is that the burden of proof lies on the complainants to show the actual profits derived from the infringement of the invention. What have the complainants done in this case to sustain this burden?

Have they proved that the Richardson invention is an essential instead of a preferred element of the Crosby combination? No. Have they proved that in the operation of the valve, those parts which constitute the infringement of the Richardson patent, have any more to do with its free rise and its quick fall after small loss, than the parts forming the second outlet? No. Have they proved that the Crosby invention, which covers the combination, which is the distinguishing characteristic of its structure, is worthless? Just the contrary; the uncontradicted proof is that it is vital. On what theory then has the Master handed over the whole profit of the defendants' business to the owner of the Richardson patent of 1866, in the absence of any proof before him that the use of that invention alone, and not in combination with the 1869 patent, or some other device, ever had any commercial value, and in the presence of the uncontradicted evidence that other inventions contributed to the commercial value of the valves which the defendants have sold?

It is submitted that, in the absence of evidence apportioning the value of the different inventions and improvements contained in the Crosby valve, the decree should be for a nominal amount of profits only.

Sixth.

It remains to notice, briefly, the Master's unexplained statement that he finds that the complainants' commercial valves contain the Richardson invention. If he means by this that he disregards the limitation that the escape orifice must be smaller than the area of entrance at the ground joint, then, for reasons already stated, he makes an error of law, and departs from the interpretation of the patent he is bound to follow. If he means that the said orifice is, as matter of fact, not larger in area than the area at the ground joint, then he disregards uncontradicted evidence, and his finding is without any proof to support it. In either case, the finding is wholly erroneous.

For the above reasons, it is respectfully submitted that the decree should be reversed and the Court below directed to enter a decree for a nominal sum, on the ground that the amount of profits derived by the appellant from the infringement, has not been proved.

EDMUND WETMORE,
J. H. MILLET,
Appellant's Counsel.

Office Supreme Court U. S.
FILED,
OCT 13 1891
JAMES H. McKENNEY,
CLERK.

SUPREME COURT OF THE UNITED STATES,

OCTOBER TERM, 1891.

No. 999.

THE CROSBY STEAM GAGE AND VALVE CO.,
Appellants and Defendants,

v.

THE CONSOLIDATED SAFETY VALVE CO.,
Appellees and Complainants.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES, DISTRICT OF MASSACHUSETTS, CONFIRMING AND RENDERING JUDGMENT ON A MASTER'S REPORT.

BRIEF

ON THE PART OF APPELLEES AND COMPLAINANTS, SUSTAINING THE MASTER'S REPORT AND THE JUDGMENT AT CIRCUIT THEREON.

THOMAS WILLIAM CLARKE,
OF BOSTON, MASS.,
of Counsel.

Complainants' exceptions were filed September 5, 1889 (*Record*, p. 348).

The cause was argued on exceptions in the October term of 1889 (*Record*, p. 350).

The opinion of the Court confirming the Master's report and overruling all exceptions was filed October 7, 1890 (*Record*, p. 352).

The decree was entered October 11, 1890 (*Record*, p. 351).

This decree confirmed and entered judgment on the Master's report for the sum of forty thousand three hundred and forty-four dollars and fifty-nine cents, with interest from the date of filing the Master's report, namely, from August 5, 1889, and for costs.

The errors assigned in the judgment of the Court below are ten in number, the first nine of which are practically identical with the first nine of the defendants' exceptions below; the tenth was taken on October 11, 1890, to the allowance of interest from the date of filing the Master's report, and claims that interest should be charged only from the entry of the decree on the Master's report, to wit, from October 11, 1890.*

*The only other proceeding after the reception of the mandate, of any consequence, was a motion to amend the answer by stating a new defence not stated in the former answer. It is understood that the appellants did not assign errors on this refusal, and therefore no argument is submitted on behalf of the appellee on this point.

ERRORS ASSIGNED CLASSIFIED.

The errors assigned are of four general sorts:

First Alleged Error.

The first appears only in the first exception below, and in the first assigned error here.

It relates to valves made by defendants and destroyed by them before sale, or after a sale and an exchange for other valves, which destroyed valves did not appear in the account on either side. These destroyed valves are thus actually or vicariously unsold valves.

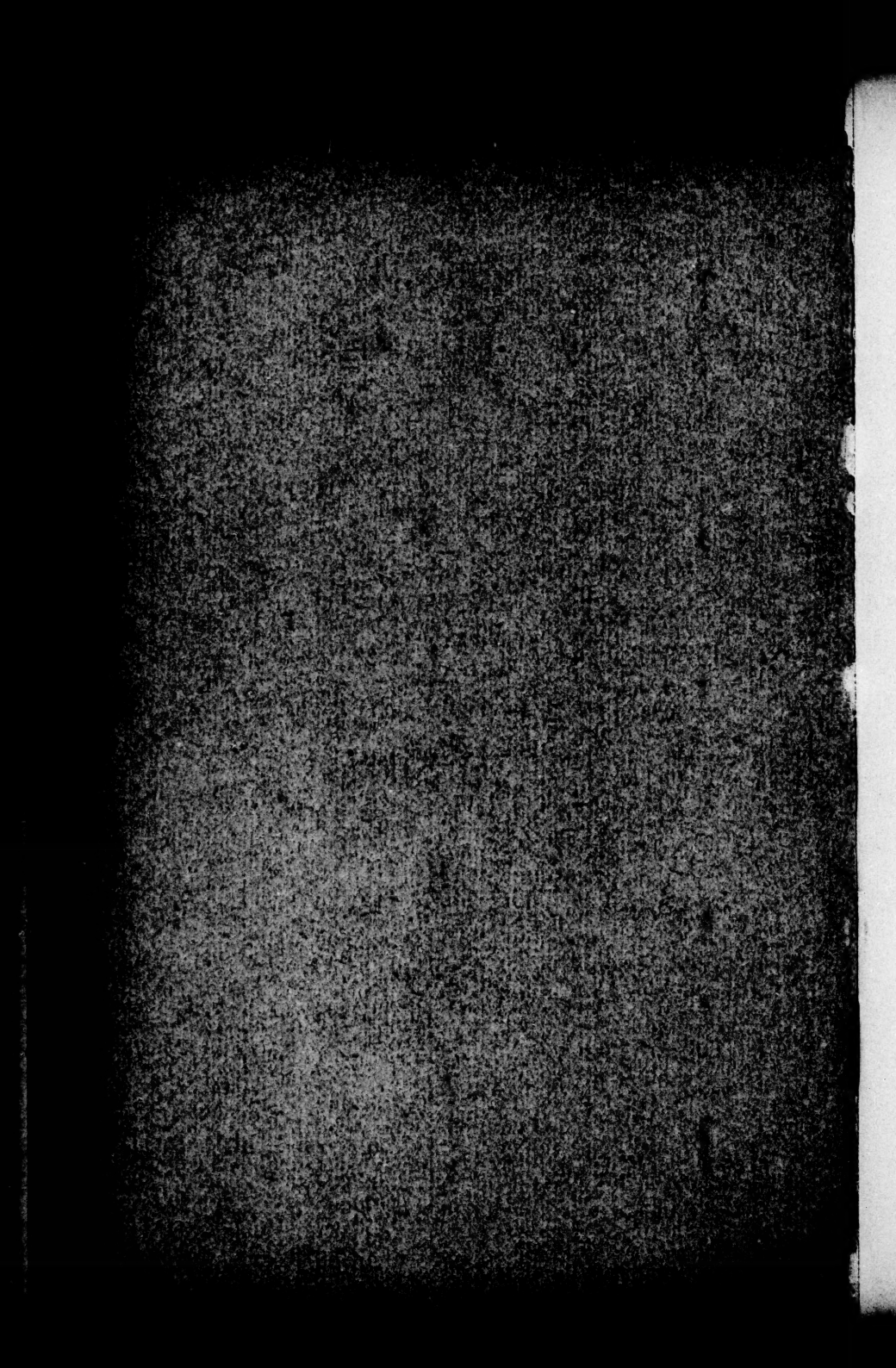
Defendants claim a credit of nineteen hundred and seventy-eight dollars and thirty-four cents, the expense incurred in making these experimental and defective valves.

Second Group of Assigned Errors.

The second group of errors are included in the 2d, 3d, 4th, 5th, 6th, 7th, and 8th exceptions below, and in the similarly numbered paragraphs of the assignment of errors here.

The general substance of the error assigned is:

1st. That the Richardson invention had no commercial value to the complainants, because they did not use it in their own manufacture (*subject of 2d exception*).



Supreme Court of the United States.

OCTOBER TERM, 1891.

No. 999.

THE CROSBY STEAM GAGE & VALVE COMPANY,
Defendants and Appellants,

v.

THE CONSOLIDATED SAFETY VALVE COMPANY,
Complainants and Appellees.

NOTE. — The complainants served on September 14, 1891, an assignment of errors to be argued before the Supreme Court, ten in number, on which assignment of errors this brief is made, before reading the appellants' brief, which was not then served.

STATEMENT.

This cause was before the Supreme Court in October term of 1884, and was remanded for reversal of decree and accounting (*Record*, p. 1).

A decree sustaining the patent and ordering an accounting was entered at circuit May 18, 1885 (*Record*, p. 5).

The Master's report in this cause was filed August 5, 1889 (*Record*, p. 7).

Defendants' exceptions were filed August 29, 1889 (*Record*, p. 345).

Complainants' exceptions were filed September 5, 1889 (*Record*, p. 348).

The cause was argued on exceptions in the October term of 1889 (*Record*, p. 350).

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Defendants claim a credit of nineteen hundred and seventy-eight dollars and thirty-four cents, the expense incurred in making these experimental and defective valves.

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The second group of errors are included in the 2d, 3d, 4th, 5th, 6th, 7th, and 8th exceptions below, and in the similarly numbered paragraphs of the assignment of errors here.

The general substance of the error assigned is:

1st. That the Richardson invention had no commercial value to the complainants, because they did not use it in their own manufacture (*subject of 2d exception*).

2d. That the state of the art showed that other safety valves previously known to the art and free to be used by the defendants (of which only one, the Webster valve, is specifically mentioned), had, or were capable of having, without borrowing anything from Richardson, a *commercial value* which was to be allowed for in the accounting. [This forms the subject of the 3d, 4th, 5th, 6th, 7th, and 8th exceptions below, and of similarly numbered paragraphs in the assignment of errors.]

Third Assigned Error.

The 3d error is set forth in the 9th assignment of errors, and alleges that the introduction into the defendants' infringing valves of the patented improvements of the Crosby patents belonging to the defendants, No. 159,157, of January 26, 1875, and No. 160,167, of February 3, 1875, had a commercial value, which could be appraised, and should have been deducted from the profits found by the Master.

Fourth Assigned Error.

The 4th error assigned is the allowance of interest from the date of the Master's report, instead of the date of final decree.

The case presented will therefore be treated under these four heads.

FIRST ASSIGNMENT OF ERRORS:

VALVES DESTROYED BY DEFENDANTS WHICH YIELDED NO RETURNS, OUGHT NOT TO BE IN THE ACCOUNT.

Defendants claim by item 7 of statement IV. of their account, and by the evidence submitted upon it, that they should be allowed the sum of nineteen hundred and seventy-eight and $\frac{84}{100}$ dollars, which is thus put in the account (*Record*, p. 89): "Cost of modification and reconstruction of iron valves in 1882, '83, prior to September 25, 1883, $1,978.84."

The Master (*Record*, p. 13) says concerning this, —

"Item 7 is for modification and reconstruction of iron valves. The costs of the reconstructed valves have already been charged in the costs of valves for the periods in which the reconstruction, so called, took place. The old valves were destroyed, and a salvage made of such parts as were of value or could be used, and new valves were made, and their full costs charged in the accounts of defendants. This item 7 is a claim for the cost of the destroyed valves (whether with or without an allowance for salvage I am unable to say), and should not be allowed. It comes clearly within the reasoning of Judge SHEPLEY in his opinion in *Graham* v. *Mason*, 1 Holmes, 88."

The defendants (*Record*, p. 27) explained their acts which led to this claim, as follows: —

"Finding 8. The charge found in item 7, in heading IV. of defendants' account filed with the

Master, is for the reconstruction and modification of safety valves made by them. The work of this modification and reconstruction was in the direction of perfecting the characteristics of the safety valves they were then producing. The result of such endeavor was that they produced a species of safety valves, classified in the account as iron safety valves, which was made and sold after that time by the defendants, the account of which has been fully rendered to the Master, and on which he has computed profits in his consideration of them.

"In the labor and efforts of the defendants certain valves were rendered useless, and were valueless except for junk, and certain parts of valves made for them and paid for were rejected, and the difference between the original cost and their value as old metal became a loss to the defendants. All these losses occasioned by the destruction of valves, by the replacing of valves in the hands of buyers of valves, by giving them new valves for old ones without additional charge, and by the destruction of parts of valves which could not be used because of the modification of the design, were a part of the expense suffered by the defendants in their valve business in the producing and manufacture of a marketable safety valve of the characteristics of the Crosby valve, and constituted a wastage in [p. 28] their business which their valve department suffered for the purpose of making more salable products. This loss was an item of expense which

should be charged to the cost of valves as such, because it became a charge upon all the safety valves thereafter made following the plan and models which resulted from such loss.

"Upon inspection of the records of the Master the defendants do not find that they have filed specifications of such loss, and, trusting to the belief that their account, with the testimony, was sufficient and proper in such respect, they evidently neglected so to do. Moreover, the examination of Mr. Crosby, the defendants' superintendent at that time, by the complainants upon that item of their account shows only the items of loss in part.

"This latter incomplete showing, which is now first noticed by the defendants, was evidently overlooked, and thus the facts making up the character of the loss were not properly and fully laid before the Master for his consideration. On this account the defendants respectfully submit a statement of facts, and request that they may introduce testimony if necessary in proof thereof.

"*Statement.*

"In the winter of 1882 and spring of 1883 certain important and valuable improvements were incorporated into the iron safety valves made by the defendants, requiring a radical and complete modification of their form and structure.

"On this account there were returned to the defendants by Messrs. Babcock & Wilcox, of New York, thirty-eight safety valves, and new ones sent

to them in their stead, for which no charge was made. They were as follows; namely, —

4	2½	-inch	iron	safety	valves.
11	3	"	"	"	"
13	3½	"	"	"	"
10	4	"	"	"	"

"These valves were destroyed as not salable after the new pattern was determined upon.

"In addition to these, there were also destroyed, as being of the same design and pattern, the following: —

19	2½	-inch	iron	safety	valves.
16	3	"	"	"	"
19	3½	"	"	"	"
15	4	"	"	"	"

together with twelve brass valves of various sizes, all of the above being mentioned by Mr. Crosby in his testimony, *Record*, p. 346.

"Those originally sold to Babcock & Wilcox were accounted for. When they were returned new ones of the new design and pattern replaced them without charge to Babcock & Wilcox by the defendants. No account of these latter valves was rendered in the defendants' account to the Master. The brass valves referred to were accounted for, and items Nos. 191, 192, and 193 treat of them as returned. None of the others were accounted for, as none were consigned or sold. The loss to the company upon [p. 29] these valves was shown by Mr.

Crosby, *Record*, pp. 345, 346, 347. [*See present Record*, pp. 153, 154.]

"Besides the destruction of these complete valves there was a loss, by the sale of 19,017 pounds of iron castings, of $475.42, arising from a sale of them at one cent per pound after a cost to the defendants of three and one half cents per pound.

"All these losses grew directly from the perfecting of the defendants' safety valves.

"Whenever valves have been accounted for as returned and the master has deducted the returned valves from the sales and costs, the account then shows itself free from any profits on such valves. The cost to the defendants of such valves remains as a part of the expenses they have incurred in the making of valves, and which, when they were destroyed, became a direct loss to them and their business. It is for this actual loss so sustained, decreasing their profits, which they now ask to have allowed. The loss is inseparable from their whole valve business and belongs to it."

To this argument the Master replied, —

"Master's note 29. — It is clear upon this statement that no allowance should be made to defendants for the sixty-nine valves which they made and destroyed without selling or consigning them. The thirty-eight valves which were originally sold to Babcock & Wilcox were accounted for both in costs and sales, but when new valves were sent them to

replace the returned valves the new valves were not included in defendants' accounts, either in costs or sales. The twelve brass valves were returned, and so treated in the account. The result, therefore, is substantially this, that the defendants made some one hundred and nineteen valves which they subsequently destroyed, with some castings which they concluded not to use. I find no sufficient reasons for modifying my former disallowance of item 7 in each case." (*Record*, p. 29.)

The Court below says (*Record*, p. 354),—

"As for the objections to the findings of the Master respecting expenses to be allowed for certain valves destroyed, which forms the subject matter of the first exception, I think the Master was right in the conclusion he reached. The defendants were not charged on valves which were subsequently destroyed, or, if so, they were not charged upon the new valves which replaced them. See Master's note 29, page 43 of Master's Report. [*Present Record*, p. 29.] The Master properly disallowed the cost of destroyed valves."

Argument on First Assigned Error.

The Court will presume the Master's report to be correct.

"In practice it is not usual for the Court to reject the report of a master with his findings upon the matter referred to him, unless exceptions are taken

to them and brought to its attention, and upon examination the findings are found unsupported or defective in some essential particular." *Kimberly* v. *Arms*, 129 U.S. 355, citing *Medsker* v. *Bonebreak*, 102 U.S. 66; *Tilghman* v. *Proctor*, 125 U.S. 136; *Callahan* v. *Myers*, 129 U.S. 617, 666. The reason given in *Kimberly* v. *Arms* is admirably clear, and of a terse literary form which ranks the statement with Maxims of the Law.

"The findings of the Master are to be taken as presumably correct. They are subject to be reviewed for manifest error in the construction given to the evidence, or in the application of the law, but not otherwise.

"They should not be disturbed, unless clearly in conflict with the weight of evidence on which they were made."

This rule thus stated by the Supreme Court has long been familiar at circuit.

Mason v. *Crosley*, 3 W. & M. 258.
Jeffrey v. *Brown*, 29 Fed. Rep. 476.
Central Trust Company v. *Wabash, St. Louis & Pacific R.R.*, 31 Fed. Rep. 476, 477.
Stanton v. *Ala. & C. R.R.*, 31 Fed. Rep. 585–587.
Central Trust Company v. *Texas & St. Louis R.R.*, 32 Fed. Rep. 448–450.
Celluloid Company v. *Cellonite Company*, 40 Fed. Rep. 476.

replace the returned valves the new valves were not included in defendants' accounts, either in costs or sales. The twelve brass valves were returned, and so treated in the account. The result, therefore, is substantially this, that the defendants made some one hundred and nineteen valves which they subsequently destroyed, with some castings which they concluded not to use. I find no sufficient reasons for modifying my former disallowance of item 7 in each case." (*Record*, p. 29.)

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Celluloid Company v. *Cellonite Company*, 40 Fed. Rep. 476.

On the facts in this case about these destroyed valves, on referring to the Master's report (*Record*, p. 28), it seems that several of the iron safety valves were originally sold to Babcock & Wilcox and were accounted for. Subsequently these Babcock & Wilcox valves were returned, and thirty-eight new ones of the new design and pattern replaced them without charge to Babcock & Wilcox by defendants, and that no account of the latter valves were rendered in the defendants' account to the Master. Thirty-eight iron valves are therefore unaccounted for in the account, and thirty-eight iron valves of the same size have been destroyed. Besides these, sixty-nine other iron valves which never went out of defendants' hands were destroyed, together with twelve brass valves of various sizes mentioned in Crosby's testimony (*Record*, p. 148, int. 59; pp. 153, 154, int. 95). By this it appears that the net cost was fourteen hundred and seventy-seven dollars and fifty-two cents, and (*Record*, p. 29) that iron castings prepared for these iron valves of old pattern were junked to the amount of nearly ten tons, — 19,017 pounds, — by which junking of the iron there was a shrinkage of two and one half cents per pound. Crosby admits and his evidence, ints. 96, 97, shows, that this claim is for the cost of all the valves and the shrinkage on all the iron castings prepared for the valves, allowing the value of composition and springs which could be used over again.

The objection to the Master's report (*Record*, p.

28) claims that the brass valves appeared in the schedule of valves returned, &c., for which allowance was claimed as items 191, fifteen dollars; 192, one hundred and thirty-five dollars (see *Record*, p. 17); and 193, ninety dollars (see *Record*, p. 18). The cost of these valves appears in the Master's schedules, 191, seven dollars and fifty-three cents; 192, eighty-one dollars (*Record*, p. 19), 193; fifty-two dollars and fifty cents (*Record*, p. 20). All these destroyed valves, therefore, have been eliminated entirely from the account, as if they had never gone out of the defendants' possession.

The defendants' contention seems to be that these valves which were destroyed should form a credit to the amount of nearly two thousand dollars against the profits actually realized on other valves.

In the most recent text book, 3 Robinson on Patents, p. 501, it is said, —

"Profits on articles sold at profit and paid for are the only subjects of inquiry; losses incurred by the defendant through his wrongful invasion of the patent are not chargeable to the plaintiff, nor can their value be deducted from the compensation which he is entitled to receive."

Graham v. *Mason*, 5 Fish. 290, 1 Holmes, 88.
Steam Stone Cutter Company v. *Winsdor Mfg. Co.*, 17 Blatch. 24; 4 Ban. & A. 445.
Piper v. *Brown*, 1 Holmes, 96.
Tilghman v. *Proctor*, 125 U.S. 136.

Mers v. *Conover*, 11 Off. Gaz. 111, quoted in 8 Sup. Ct. R. 898.
Elizabeth v. *Pavement Co.*, 97 U.S. 138.
The Cawood Patent, 114 U.S. 118.

An infringer and a patentee are not in partnership in the business of making and selling the infringing article, so as to include the expense of experimenting and fitting up. The infringer's accountability begins when he sells. His rights to credits are confined to credits on the things sold. This is a claim for consequential and indirect credit as inadmissible as indirect damages would be.

The first exception was rightly overruled below, and the first assignment of error here contains no error.

SECOND ASSIGNMENT OF ERROR:

Embodiment of the Richardson Invention in the Complainants' Commercial Valves.

In the judgment in the principal case, 113 U.S. 157, it is said, pp. 172, 173,—

"It appears to have been easy enough to make a safety valve which would relieve the boiler, but the problem was to make one which, while it opened with increasing power in the steam against the increasing resistance of a spring, would close, suddenly and not gradually, by the pressure of the same spring against the steam. This was a problem of the rec-

onciliation of antagonisms which so often recurs in mechanics, and without which practically successful results are not attained. What was needed was a narrow stricture to hold back the escaping steam, and secure its expansive force inside of the lip, and thus aid the direct pressure of the steam from the boiler in lifting the valve against the increasing tension of the spring, with the result that, after only a small, but a sufficient, reduction in the boiler pressure, the compressed spring would, by its very compression, obtain the mastery and close the valve quickly. This problem was solved by Richardson, and never before."

Page 176: "Richardson is, therefore, entitled to cover by the claim of his patent of 1866, under the language, 'a safety valve with the circular or annular flange or lip *c c*, constructed in the manner or substantially in the manner shown, so as to operate as and for the purpose herein described;' a valve in which are combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air, the orifice being proportioned to the strength of the spring, as directed."

Page 179: "Richardson's invention brought to success what prior inventors had essayed and partly accomplished. He used some things which had been used before, but he added just that which was necessary to make the whole a practically valuable and economical apparatus. The fact that the known

valves were not used, and the speedy and extensive adoption of Richardson's valve, are facts in harmony with the evidence that his valve contains just what the prior valves lacked, and go to support the conclusion at which we have arrived on the question of novelty. When the ideas necessary to success are made known, and a structure embodying those ideas is given to the world, it is easy for the skilful mechanic to vary the form by mechanism which is equivalent, and is therefore, in a case of this kind, an infringement."

Defendants Point to no Evidence on their Contention.

There is no specification in the assignment of errors, nor was there in the exception below, of the evidence on which the Master should have found that the complainants' valves of commerce did not contain the improvement set forth in the Richardson patent of 1866.

The Master found specifically that they did (*Record*, p. 15).

"Upon the whole evidence, with specimens of all the different valves put on the market by the complainants before me, I find that they all contained Richardson's improvement of 1866."

These words of the Master could not be improved by the Court at circuit, and in the opinion filed October 7 (*Record*, p. 353), this langnage was taken, approved, and adopted by the Court.

Thus it has been twice found as a fact that the complainants' valves of commerce did contain the Richardson patented improvement.

The appellants' contention rests on a matter of fact, and this matter of fact has been twice found against them.

The Point Immaterial.

The fact, however, in consequence of the form of the finding is immaterial.

The Master's report was for profits and not for damages.

If damages had been adjudged, and one element of those damages had been the loss of trade by complainants, in consequence of the defendants' competition, it would have been material on the part of the complainants to show that they were putting upon the market goods embodying the Richardson invention; but as the complainants have only recovered the advantages which the defendants have derived from using the Richardson invention in their business, without complainants' consent, it was immaterial whether they themselves employed the invention.

Profits are what defendants made from the use of complainants' property, and this amount can neither be enhanced nor diminished by any act on the part of the complainants.

It is not affected at all by the fact that at the same time the complainants did or did not use that prop-

erty, just exactly as in a case of trepass to real estate, in cutting sods for instance, the fact that the owner did not propose to cut sods himself, and was not even pasturing the land, would have no effect at all in diminishing the damages, although if they were cut on the home lawn of plaintiff's country villa, special damage above the market value of sods might be shown.

This Court will probably not devote its time to considering an immaterial fact which has been twice found contrary to appellants' contention by previous competent and proper tribunals.

The 5th and 6th assignments of error involve the same matter of fact already treated of in the second, and as this matter of fact is immaterial in an accounting of profits, it furnishes no reason for disturbing the finding of the Master in profits, and as upon that matter of fact the finding is properly the other way, as the Master and the Court have said, there is surely no reason on that account to disturb the finding.

THIRD ASSIGNMENT OF ERROR.

All Profits due to use of Richardson's Invention.

The 3d, 4th, 5th, 6th, 7th, and 8th exceptions relate to an alleged error of the Master in attributing all the profits to appellants' employment of the improvement of the Richardson patent of 1866.

These exceptions assumed that the state of the art

discloses, particularly in the Webster patent, which was before this Court in 1884 when complainants' appeal was argued and sustained, a *method of constructing safety valves which had a commercial value*, and was capable of yielding some profit when commercially worked.

The Master had before him the evidence in the principal case on which the opinion of this Court was rendered, 113 U.S. 157. Upon that as a *prima facie* case the complainants made their charge in profits (*Record*, p. 91), in which charge it was stated (*Record*, p. 112),—

"And complainants further say, in case No. 1184, that had not the valves hereinbefore scheduled in this charge contained the invention patented to George W. Richardson, September 25, 1866, and the property of the complainants, the defendants could not have sold the said valves for any greater sum of money than hereinbefore taken as the cost thereof, and that by virtue of containing the said invention, and for no other reason or reasons, the defendants were enabled to sell the valves hereinbefore scheduled at a profit of $52,698.62, which they would not otherwise have realized; and complainants aver that the sum of $52,698.62 was the profits derived by the defendants from their unauthorized use of the Richardson patent of 1866, as above set forth."

Upon this charge the defendants filed a discharge of which the 6th paragraph, (*Record*, p. 117) con-

fesses that the Richardson patent had commercial value.

"The valves manufactured and sold by the defendants contained divers inventions and improvements, and are an aggregation of the several inventions described in the English Letters Patent to Ritchie in 1848, and in the English Letters Patent to Webster in 1857, and in the reissued Letters Patent to Waterman, to which are added the improvements described in Letters Patent to George H. Crosby, under which the defendants' valves are specially manufactured; that the whole sum which the Master shall find as the profits which have accrued to the defendants, after deducting the proper sums for bad debts, expenses, &c., — the balance remaining fairly referable to the said improvements and characteristics described in expired and existing patents, — should be apportioned as follows: And in discharge of the complainants' charge the defendants say, —

"There should be assigned of said sum —

"To the Ritchie and Webster patents, say fifty per cent.

"To the inventions and improvements of George H. Crosby, say forty per cent.

"To the reissued Waterman patent or the Richardson patent of 1866 (to whichever of them the Master shall find is entitled to the same), say ten per cent."

The Master rightly considered the judgment of this

Court in the principal case, 113 U.S. 168, as finding several facts conclusively.

This Court said, reviewing the opinion of Judge LOWELL, —

"The view taken by the Circuit Court, in dismissing the bills, was that some valves had been made before 1866 which embodied the same general principle as Richardson's, and were of some value, operating through the expansive power of steam exerted upon an additional chamber outside of the ground-joint; and that what Richardson did was to so regulate the action of the chamber outside of the ground-joint, by a crack or opening between the lip of the valve and its main body, that the steam would be confined or huddled when it sought to escape from the chamber, and so the valve would be held up just long enough and could fall rapidly before too much steam was lost. But the cases went off on the question of infringement, and the Circuit Court found, that while the defendant's valve employed an additional surface to lift the valve as soon as it began to blow, and the pressure was regulated in part by a stricture, it differed from the plaintiff's in that the additional area was not outside of the ground-joint, but inside, and was not acted on independently of the valve itself, but was a part of it, and the escaping steam did not act at all by impact, but wholly by expansion. The conclusion was, that as Richardson was not the first to apply the idea of an additional area or of a stricture, he could not enjoin a valve which resembled his

invention, known or recognized as producing any such result as his apparatus of that patent produces as above defined. Likenesses in them in physical structure to the apparatus of Richardson in important particulars may be pointed out, but it is only as the anatomy of a corpse resembles that of the living being. The prior structures never effected the kind of result attained by Richardson's apparatus, because they lacked the thing which gave success. *They did not have the retarding stricture which gave the lifting opportunity to the huddled steam, combined with the quick falling of the valve after relief had come. Taught by Richardson, and by the use of his apparatus, it is not difficult for skilled mechanics to take the prior structures and so arrange and use them as to produce more or less of the beneficial results first made known by Richardson;* but, *prior to 1866*, though these old patents and their descriptions were accessible, *no valve was made producing any such results.* Richardson's patent of 1866 states that the addition to the head of the valve terminates in an annular lip, which fits loosely around the valve-seat, and is separated from it by about one sixty-fourth of an inch for an ordinary spring, and a less space for a strong spring, and a greater space for a weak spring, forming an annular chamber and regulating the escape of the steam; that the steam when the valve is lifted, passes beyond the valve-seat and into the annular chamber, and acts against the increased surface of the valve-head,

and thus overcomes the increasing resistance of the spring due to its compression, and lifts the valve higher, and the steam escapes freely into the open air until the pressure is sufficiently reduced, when the spring immediately closes the valve. *It is not shown that before 1866 any known valve produced this result.* On the contrary, Richardson testifies that for about twenty years before 1866 he was acquainted with safety valves in practical use, by working in the locomotive repair shops of railroad companies, part of the time as foreman, and as a locomotive engineer, and that he never, before his invention, knew, in practical use or on sale, of a spring-loaded safety valve capable of opening to relieve the boiler when the working [p. 172] pressure was exceeded, and of automatically closing with a small loss of working pressure. He also says that he was in England for about four months in 1873, bringing his valve to the notice of officials in the shops of some of the largest railroad companies, his valve being one especially useful on locomotive engines on railroads; that while he was in England he found no man who professed to be acquainted with, or to have heard of, a safety valve which would automatically open and relieve the boiler at a predetermined working pressure, and automatically close when such working pressure had been slightly reduced, or who admitted that such a valve could be made, until he had seen Richardson's valve work; that the master mechanics at the shops named did

not believe he could make a valve close within twenty-five pounds of the blowing-off point; that he showed them the working of his valve with no excess beyond working pressure, and with but 3 to 5 pound's reduction from a pressure of 130 pounds per square inch in the boiler; that he did not hear in England of any of the Ritchie, Webster, or Hartley valves, but heard the Naylor valve blow; and when it blew the steam rose several pounds above the point where it commenced to blow, and it did not close promptly, tightly, or suddenly. There is no evidence to contradict or vary the effect of this testimony.

"Thomas Adams, of Manchester, England, who has spent a lifetime in the manufacture and practical working of safety valves, testifies that the Ritchie and Webster valves have never been in use practically in England, and the Hartley only in two or three cases, when it was a failure; that he himself has made and applied in England about 15,000 of Richardson's valves; that if loaded at 120 pounds per square inch, his valve returns to its seat with a very small loss of pressure; that the Beyer valve, loaded at 120 pounds, reduces the pressure 30 pounds before returning to its seat; and that Naylor's has been superseded by Richardson's.

"It appears to have been easy enough to make a safety valve which would relieve the boiler, but the problem was to make one which, while it opened with increasing power in the steam against the

increasing resistance of a spring, would close [p. 173] suddenly, and not gradually, by the pressure of the same spring against the steam. This was a problem of the reconciliation of antagonisms which so often recurs in mechanics, and without which practically successful results are not attained. What was needed was a narrow stricture to hold back the escaping steam, and secure its expansive force inside of the lip, and thus aid the direct pressure of the steam from the boiler in lifting the valve against the increasing tension of the spring, with the result that, after only a small, but a sufficient, reduction in the boiler pressure, the compressed spring would, by its very compression, obtain the mastery and close the valve quickly. *This problem was solved by Richardson, and never before.* . . .

"Ritchie's patent, in speaking of his valve, says, 'This valve is weighted by a helical spring, *i* (shown at fig. 2), of sufficient power according to the required pressure of the steam; and when it is intended to be used as a reserve safety valve, I place the spring around that part of the stem below the valve, that is to say, within the boiler, as shown at fig. 2. The [p. 174] advantage of this form of construction of valve over the ordinary valve is as follows: As soon as the pressure of steam raises the valve from its seat, the flange *h*, being exposed to the pressure of the steam, presents an increased surface which compensates for the increasing resistance of the helical spring *i*, until the valve has been raised to a

not believe he could make a valve close within twenty-five pounds of the blowing-off point; that he showed them the working of his valve with no excess beyond working pressure, and with but 3 to 5 pound's reduction from a pressure of 130 pounds per square inch in the boiler; that he did not hear in England of any of the Ritchie, Webster, or Hartley valves, but heard the Naylor valve blow; and when it blew the steam rose several pounds above the point where it commenced to blow, and it did not close promptly, tightly, or suddenly. There is no evidence to contradict or vary the effect of this testimony.

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height equal to the area of the steam-way, when it allows the steam or vapor to escape freely.' In an article in 'The Artizan,' published in England in July, 1858, signed by Ritchie, and referring to his patent of 1848, it is said of his valve, 'The top area being made double that of the under side or steam-way, such a valve would quickly reduce the pressure in the boiler to half that at which the valve lifted; and so, also, of other proportions. Hence it is chiefly suited for a reserved valve.' This shows the existence of the very evil which Richardson remedied. Ritchie's patent and publication say nothing about any stricture.

"The evidence in the present case shows satisfactorily that valves made in conformity with the measurements of the drawing of Ritchie's patent do, in practice, reduce the pressure in the boiler to such an extent, after that pressure is properly relieved, and before they close, as to involve great loss of time and consumption of fuel before the initial pressure is restored. The experimental valves produced by the defendant as structures made according to Ritchie's patent vary from the dimensions of his drawing, and the variations are those which result from the instructions given by Richardson in his patents. *Ritchie gives no information how to make a valve work at a predetermined pressure, or how to make it work with a small range of difference between the opening and closing pressures, or how to proportion the strength of the spring and the size of*

the stricture to each other. The same thing is true of the Webster and the Hartley patents.

"*The Webster patent shows a huddling chamber and a stricture.* But the evidence shows that valves made with the proportions shown in the drawings of the Webster work with so large a loss of boiler pressure, before closing, as to be practically and economically worthless. Webster's patent describes a means of making the area for the escape of steam adjustable [p. 175], consisting in adjusting up and down, on a smooth valve-stem, a sliding collar or flange, and fixing it in place by a set-screw. But it does not show the screw-ring of Richardson, with its minute delicacy of adjustment and action.

"Nothing further need be said as to the Hartley valve or the Beyer valve.

"The original patent to Waterman was issued in 1853. His attention had been turned to the subject of safety valves for locomotive engines. He invented what is described in that patent, but he testifies that, before 1866, he never saw a safety valve capable of keeping the pressure at a point not above working pressure, and of relieving the boiler with but a small loss of pressure; that his valve would let the steam down about fifteen pounds, and was not practical for an ordinary locomotive; and that the Richardson valve, when introduced, went at once into general use. The Waterman valve had a supplemental surface, on which the steam acted to aid in the raising of the valve; and this was shown in the

drawing of Waterman's original patent, but the specification did not describe it. Waterman's original patent did not show the use of the spring, and prior to its reissue his valve had not been made with a spring. After Richardson obtained his patent of 1866, and Waterman knew of Richardson's valve, they combined the interests in their two patents, and the reissue of Waterman's was obtained, with the co-operation of Richardson, he signing as a witness the specification of the reissue. The specification, granted in 1867, describes an overhanging part of the valve as increasing its area outside of, and beyond, the ground-joint, and a concentric rim or ledge, which directs the steam upward against such overhanging part of the valve, so that the valve is assisted in rising. The specification was drawn in view of Richardson's patent and valve, and for the purpose of making a claim, which was then made, and which was not in Waterman's original patent, to a combination of the concentric rim or ledge with the overhanging part of the valve. The specification states that the valve and its seat are so constructed that the escaping steam will act on an increased area of the valve after it has risen from its seat, and strike the overhanging or projecting annular surface above, and outside of, and beyond, the ground-joint. It also states that a proper modification of the overhanging or [p. 176] projecting annular surface will modify the force of the steam, that if such surface be large, the valve will be

opened suddenly and discharge so much steam that the pressure in the boiler will be considerably reduced before the valve closes; that such surface may be made so small that but little more than the surplus steam will escape; that the success or efficiency of the valve will depend on a proper proportion between the overhanging annular surface and the concentric rim or ledge, because, if a free discharge of steam between them is allowed, the valve will not be assisted in rising, and if the escape of steam is too small, the valve will rise too easily and remain open too long, and the steam will be so much reduced in pressure as seriously to impair the economical and efficient action of the apparatus; and directions are given as to the sizes of the overhanging part, and of the ledge or rim, and of the opening, for a valve of a specified diameter, acting with a specified pressure of steam. Nothing of all this was found in the specification of the original Waterman patent. It therefore has no effect, as against Richardson's patent of 1866, to destroy the validity of that patent.

"If anything which Richardson did in respect to reissuing the Waterman patent could in any event affect the rights of the present plaintiff under either patent sued on, as to which we express no opinion, it is sufficient to say that the present defendant claims in its answers no benefit from any action of Richardson's in respect to the Waterman patent, as

operating in its favor or enuring to its benefit, as an equitable defence in these suits.

"Richardson is, therefore, entitled to cover, by the claim of his patent of 1866, under the language, 'a safety valve with the circular or annular flange or lip *c c*, constructed in the manner, or substantially in the manner, shown, so as to operate as and for the purpose herein described,' a valve in which are combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air, the orifice being [p. 177] proportioned to the strength of the spring, as directed. The direction given in the patent is, that the flange or lip is to be separated from the valve-seat by about one sixty-fourth of an inch for an ordinary spring, with less space for a strong spring and more space for a weak spring, to regulate the escape of the steam as required. As matter of law, this description is sufficient, within the rule laid down in *Wood* v. *Underhill*, 5 How. 1, and it is not shown to be insufficient, as a matter of fact."

One would think that Webster, and Ritchie, and Naylor, and Beyer, and Hartley, and Waterman were out of this case when that opinion was given, and that in proceeding in conformity with it, we should hear no more of them.

The Master (*Record*, p. 14) fairly thought he had some settled questions of fact before him. He says, —

"In this accounting in No. 1184 for the period from February 15, 1879, to September 25, 1883, I attribute the entire commercial value of the valves manufactured and sold by the defendants to the improvement covered by Richardson's patent of 1866." He summarizes the result of the previous litigation in this case as follows: —

"Richardson's invention, as described and claimed in that patent [the patent of 1866], revolutionized the art of relieving steam boilers from steam pressure rapidly approaching the dangerous point. It made effective for that purpose — rapidly and with comparatively small loss of steam — apparatus described in other patents, which very nearly embodied Richardson's invention, but did not actually contain it. The Supreme Court in these cases has defined this invention, and has declared it to be a vital one, — a life-giving principle to structures very nearly approaching but not quite containing an embodiment of Richardson's discovery.

"It is contended before me that none of the complainants' valves of commerce contained this invention of Richardson, but, upon the whole evidence, with specimens of all the different valves put on the market by the complainants before me, I find that they all contained Richardson's improvement of 1866. The Supreme Court has decided in these cases that the defendants' valves contain this invention, and it is under this decision that the accounting in No. 1184 is before me. *Eliminate this invention from the*

defendants' valves, and they would be commercially worthless. No substitute for this invention has been suggested to me, and I know of none which the defendants could have used in its place to have made their valves of commercial value."

This statement of the standpoint of the Master is approved by the Court below in the Master's words (*Record*, p. 353).

In an accounting, the result of the evidence in the principal case is held by the Court, which directs the accounting to be a thing unchangeable.

Skinner v. *Vulcan Iron Works*, 39 Fed. Rep. 870.

No specific reference to any of the valves alleged by the 4th exception to have been previously known to the art and free to the defendants to be used, except to the Webster valve, is found either in the exceptions below or in the assignment of errors.

Concerning the Webster valve, defendants say (8th exception, page 347, 8th assignment of error) that steam safety valves of the Webster type, free to be used by the defendants, and containing an initial area, an additional area, and an annular chamber beneath the additional area, having a non-strictured orifice leading from such chamber to the open air, were capable of operating, when properly proportioned, and without changing the annular chamber into a huddling chamber with a strictured orifice,

with an economy equal that of valves containing the Richardson invention of 1866.

This Court, 113 U.S. 170, have said,—

"In regard to all the above patents (including the Webster) adduced against the Richardson patent of 1886, it may be generally said that they never were, in their day and before the date of that patent or of Richardson's invention, known or recognized as producing any such result as his apparatus of that patent produces as above defined [referring to the definition in the Ashcroft case, 97 U.S. 189]. Likenesses in them in physical structure to the apparatus of Richardson in important particulars may be pointed out, but it is only as the anatomy of the corpse resembles that of the living being. The prior structures never effected the kind of result attained by Richardson's apparatus, because they lacked the thing which gave success. They did not have the retarding stricture which gave the lifting opportunity to the huddled steam, combined with the quick falling of the valve after relief had come."

Page 174: "The Webster patent shows a huddling chamber and a stricture. But the evidence shows that valves made with the proportions shown in the drawings of Webster work with so large a loss of boiler pressure, before closing, as to be practically and economically worthless."

With this statement of fact before them in the principal case, the defendants undertook to show

that valves called Webster valves could be made to operate something like the Richardson valve, emphasizing the result of the principal case as thus stated: (113 U.S. 171)

"Taught by Richardson and by the use of his apparatus, it is not difficult for skilled mechanics to take the prior structures and so arrange and use them as to produce more or less of the beneficial results first made known by Richardson; but, prior to 1866, though these old patents and their descriptions were accessible, no valve was made producing any such results."

Page 174: "Ritchie gives no information how to make a valve work at a predetermined pressure, or how to make it work with a small range of difference between the opening and closing pressures, or how to proportion the strength of the spring and the size of the stricture to each other. The same thing is true of the Webster and the Hartley patents."

The proportion of the size of the stricture to the strength of the spring was one of the features which Richardson particularly described, and the knowledge of which gave him control of the working of his valves. The patent of 1866 was stated (113 U.S. 176, 177) to cover "a valve in which are combined an initial area, an additional area, a huddling chamber beneath the additional area, and a strictured orifice leading from the huddling chamber to the open air, the orifice being proportioned to the strength of the spring, as directed."

The width of the stricture for an ordinary spring was defined.

NO EVIDENCE WAS OFFERED BEFORE THE MASTER OF ANY COMMERCIAL USE OF THE WEBSTER VALVES.— NO EVIDENCE WAS OFFERED THAT SHOWED THEY HAD ANY COMMERCIAL VALUE.

There is a *singular omission*, in all of the exceptions and assignments of error now under consideration, *to allege that the safety valves known* to the art *and open* to be used by the defendants, *would do the same work as the Richardson* valves and *have an equal, or indeed any, commercial value.*

Unless some evidence was given of commercial value in these Webster valves, some evidence that they were something more than a mechanical gymnastic, they do not affect the finding of profits, for unless the defendants could have made some profit out of manufacturing and dealing in such valves as they produced before the Master and called Webster valves, the Master's finding is correct, that *the whole commercial value of the defendants' valve was due to the presence in it of the invention in it of the Richardson patent of* 1866.

There is no evidence now, any more than there was in the principal case, that any Webster valves were ever made or used except those employed in the specimens of this and cognate litigation upon the Richardson patent, — a few hours' experimenting with less than half a dozen valves, on a testing boiler,

Black v. Thum 111, U.S. 122.

during not over thirty different days in thirty years, manipulated by *Hoadley*, a high-grade mechanical engineer, by *Burnett*, an ex-chief of the United States steamboat inspection, and *Harrison*, late engineer in the navy, three ring masters putting the trick pony through his circus paces for a single act.

The 3d, 4th, 5th, 6th, 7th, and 8th assignments of error should be overruled.

The Crosby Contribution of no Commercial Value.

The 9th assignment of error relates to the presence in the defendants' valves of certain alleged improvements covered by two Letters Patent in force during the whole period covered by the accounting, namely, Letters Patent granted to Crosby, dated January 26, 1875, No. 159,157; dated February 23, 1875, No. 160,167, and claims that these improvements were the cause of some portion of the profits derived by the appellants from the manufacture and sale of safety valves.

The Master (*Record*, p. 15) says —

"Defendants claimed that some of the profits which they have made are due to the peculiar form of their valves, but the form which they use in making their valves was the form in which they clothed the Richardson invention, the life of their valves, and without that life the Crosby form is worthless."

The objection of the defendants to this finding (*Record*, p. 33) is as follows: —

"The Master, having determined that the defendants had derived certain profits from the manufacture of their Crosby valves, assigned all these profits to the complainants upon the reason that the entire commercial value of the valves mauufactured and sold by the defendants is due to the improvement covered by the Richardson patent of 1866, without which the Crosby form is worthless; while he ought to have found upon the evidence that, with the exception of an allowance of a nominal sum for profits on account of the Richardson invention, these profits accrued to the defendants from their employment of the Crosby inventions and improvements."

The Master says concerning this (p. 34), —

"I have clearly set forth my views as to the value of the Richardson invention of 1866, in two paragraphs of my first draft report, commencing near the bottom of page 10 (*Record*, pp. 14, 15), and I make no change in these paragraphs upon consideration of the grounds above stated."

There was some evidence before the Master which relates to the form of the Crosby valve, to the effect that it had an encased spring, and was readily attached and adjusted, and that these features of construction were advantageous. The exceptions and assignment of errors appear to assume, but do

not state, that these constructive features were patented. The Crosby patents are not in the present record, but were in the Supreme Court record of 1884, No. 127, before the Master. They are found at pages 74 and 75 of that Record, No. 127. The patent of January 26, 1875, No. 159,157, does not show any encased spring, and the spring is held down by the objectionable yoke. The claims relate solely to the parts for producing and regulating the recoil action of the steam. The patent of February 23, 1875, No. 160,167, shows indeed the encased spring, but its four claims relate solely to the features which produce and regulate the recoil action of the steam.

The patented improvements of Crosby then were, as stated by the Master, "the form in which they clothed the Richardson invention [*Record*, p. 15], the life of their valves, and without that life the Crosby form is worthless."

No evidence is pointed out by the exceptions or by the assignment of errors from which the inference cad be drawn that there was a commercial value in the Crosby patented features. The Crosby patents are not before the Court otherwise than as the record in the principal case is before the Court. If the patents are referred to, it will be found that there is no evidence in this case that any one of the patented things gave any advantage to the salesman. [The salesman's evidence is found *Record*, p. 189, ints. 29 to 31; p. 201, int. 173; p. 202, int. 175. The Crosby

patents are found in the principal case, *No. 127 of October Term*, 1884, pp. 74, 76.]

The 9th assignment of error should be overruled.

Clearly, no apportionment should be had between a patented feature which gave all the salable quality, and an unpatented feature which was only a competitive form, or a patent which was so clearly a mere colorable change that its claimed features are not even mentioned by the salesman who gives the only testimony on this branch of the case.

Interest from August 5, 1890, Properly Allowed.

The 10th exception is to the allowance of interest.

All the wrong that was done to the complainants was done before the 25th of September, 1883. If the defendants had done justice to the complainants they would have paid them, on or before that date, the profits decreed in this case to the amount of $40,344.59.

It was nearly six years after that date — only, in fact, fifty days less — before we were able to obtain from the Master his report of the amount of the defendants' profits.

Had defendants treated us with justice, this sum would have earned us over $14,000, in the time they held us off, before we were able to say to a Court, this is what belongs to us.

Up to the present time, the interest would have amounted to more than forty-eight per cent, or an

enhancement of the recovery by nearly twenty thousand dollars.

Surely in the pursuit of a patent infringer to recover the profits he has made from his infringement, there should be a time when the further withholding of the patentee's legitimate property should become a burden on the wrongdoer, and not a benefit to him.

This time, it is claimed by the appeal, should be the time when the Court decrees that the Master's report shall be confirmed, and orders judgment to be entered.

This time, it was thought by the Court below, should be a time prior to the actual entry of the final decree, for certainly any delay caused by the Court in considering and coming to a conclusion on the case as presented, should not work a hardship upon the complainant by depriving him of interest on a confirmed report, during the time that the Court has been preparing the minutes of its judgment, because that is a delay due to the machinery of justice, and should not work a detriment to the complainant, or an advantage to the defendant.

The day, therefore, of the argument of the exceptions to the Master's report is the latest day from which it is proper that interest should run.

But the day of argument is subject to many postponements, for the convenience of the Court in hearing the cause, the convenience of counsel in presenting it, the magnitude and importance of the

exceptions to be argued, and various other reasons, so that this day is not a fixed time that can be assumed without detriment to either party.

Another day might be the day assigned by the rules of Court for the presentation of exceptions; but if no exceptions were presented, then there would be thirty days' delay; and if the day of presenting the exceptions was the day at which interest began to run, — in a case where the report was acceptable to both parties, if the defendant should wish to settle at once, he might fairly claim that interest should be deducted in case of a payment which preceded the lapse of thirty days, and so the recovery be less than the reported dues.

The true time when it is proper to consider the account as a liquidated account is the day when the Master's report is filed; and by making interest run from that day, a definite time is fixed, which has a reason to justify it, not found for any earlier date, and which is without the objections belonging to later dates.

THE ALLOWANCE OF INTEREST FROM THE DATE OF FILING THE REPORT IN COURT WAS CORRECT.

It accords with the local law, Pub. Sts. of Mass. c. 171, sec. 8: "Provided, when judgment is made up upon an award of county commissioners, a committee, or referees, or on the report of an auditor, or master of chancery, or on a verdict of a jury,

interest shall be computed upon the amount of the award, report, or verdict from the time when made to the time of making up the judgment."

In this case no interest has been allowed by the Master pending the proceedings. The rule of the Public Statutes has been exactly followed.

The Master found the balance due before the patent expired, — before September 26, 1883, — and the Court has approved this finding, with interest from August 5, 1889, the day of filing, leaving us uncompensated for nearly six years' detention.

When a Master's report was returned in vacation, and made up to the first day of the succeeding October term, this Court, in restating the money judgment to be recovered, allowed interest from the date of the submission of the report to the Court, to wit, the first day of the October term of 1884.

Tilghman v. *Proctor*, 125 U.S. 136.

Interest was allowed from the date of the Master's corrected report, in *Ill. Central R.R.* v. *Tirrell*, 110 U.S. 301.

In a Massachusetts case considered upon a Master's report at the last term of the Court, interest was allowed from the date of the return of the Master's report.

Mass. Benevolent Asso. v. *Mills*, 11 S.C. R. 234.

SUMMARY.

The alleged error which claims an additional credit to the defendants of $1978.34 for valves destroyed, should be overruled.

The alleged error which claims as matter of fact that complainants' commercial valves did not contain the Richardson invention of the patent of 1866 should be overruled.

The alleged errors which claim that the Master erred in attributing the entire profit-earning capacity of the defendants' manufacture to the employment in it of the Richardson invention of the patent of 1866 should be overruled.

The alleged error which claims the disallowance of interest prior to the date of judgment, October 11, 1890, should be overruled.

The appeal should be dismissed, and a mandate issued to the Court below affirming its judgment, and ordering its execution.

Boston, September, 25, 1891.

IN THE

Supreme Court of the United States.

OCTOBER TERM, 1891.

THE CROSBY STEAM GAUGE AND VALVE COMPANY,
APPELLANTS AND DEFENDANTS,

v.

THE CONSOLIDATED SAFETY-VALVE COMPANY,
APPELLEES AND COMPLAINANTS.

Supplemental Brief for Appellees and Complainants.

THOS. WM. CLARKE,
for Appellees and Complainants.

WASHINGTON, D. C.
GIBSON BROS., PRINTERS AND BOOKBINDERS.
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Supplemental Brief for Appellees and Complainants.

Appellants urge, on page 11 of their brief, that the Court should allow the expense of their fruitless experiments, voluntarily incurred by them, which resulted in loss because of some defect in the working of the valves, and give as a reason for it that the Master held that their entire valve business was to be taken into account in estimating the profits made for the infringements complained of, and that the cost of lost samples, uncollected bills, discounts, commissions, and the like were to be allowed as credits to the defendants, and that the account should not be not stated as an account of 24,024

different infringements, each of one valve, each valve having a separate account made up of profit and loss, and each valve being considered independently, and paying a profit to the complainants, if there was profit, but being dropped from the account if it yielded no profit.

This was the contention of complainants, stated more at large by the Master on page 10 of the Record, in which the contention of the complainants is set forth at large, and the ruling of the Master was made upon it in the form contained in pages 11 and 12 of the defendants' brief. This contention of the complainants was further emphasized in their 3d, 4th, 5th, and 6th objections. (Record, pages 23 and 24.)

There is a clear distinction between the situation on which the Master made the ruling, and the situation on which the defendants and appellants claim that it should apply.

In the cases in which the Master allowed the valves yielding no profit to become chargeable in the account, these valves were merchandized and actually went into the market.

In the disallowed cases, where the valves were destroyed by the manufacturer, they staid in the shop and never became articles of commerce.

It is noticeable that the claim made in the defendants' account on page 89 of the Record, item 7, is cost of modification and reconstruction of iron valves in 1882, 1883, prior to September 25, 1883, $1,978.84 (203).

This item was vouched by Crosby's testimony (Record, page 148, interrogatory 59). When he was asked what the item referred to and what its elements were, he replied he could not give an account of this without looking it up; and page 153, interrogatory 95, where he tells what made up the items; and page 154, interrogatories 96, 97, and 98, where he still further explains the amount of the modification, and interrogatory 99, Why were these valves destroyed; by accident or purposely? "Answer. Because we were making modifications of the valves at the time to improve them." This is all the evidence offered before the Master upon the subject. The statement made on pages 27 to 29 of the Record is entirely without evidence, but the Master ruled upon it as if it had been proved; so that if there is anything in the statement other than what was stated by Crosby, that the valves were destroyed because an improved form had been reached, the matter would require a new reference to the Master to find the facts.

Complainants did not assent to, but protested against, the method of stating the account by the Master, which included in it valves which had not returned a new dollar for an old one; but as the Master had dealt with the general expense charge so that there was no fixed gross cost for the valves, but their gross cost, including general expenses, varied with their selling prices, it would have required an entire restatement of the account by the Master in order to rectify this matter, and produce and

evolve an account which should fairly show valves yielding profit and those on which there was a loss. As the case had been twenty months before the Master from the time it was argued to him in December, 1887, until his report was filed in August, 1889, and the entire change would have been only a few thousand dollars, probably much less than the expense of rectifying the error, the complainants left the account in the condition in which the Master left it, and this more particularly because it would have needed an appeal to this Court to distribute the general expenses otherwise than in the ratio of selling prices; because the case of *Hitchcock* v. *Tremaine* (9th Blatchford, 385) had held that general expenses were to be distributed according to the receipts from sales among the different articles in which the infringer dealt. This was very proper and worked no injustice where the infringer was a mere dealer, working on commission and buying to sell again, and selling at fixed prices and always realizing a profit; but it worked very differently when the infringer was a manufacturer and sold at variable and fluctuating prices.

2. The next contention of the appellants is that they have a right to show in this proceeding before the Master that the Richardson patent valve, belonging to complainants, is a very bad valve, and that the Webster valve, which was open to the public, is a very good valve, and that the appellants, being entitled to make the Webster valve, should only be held liable for the profits which they made over and

above what they could have made if they had manufactured the Webster valve instead of the Crosby valve.

This ingenious contention might, perhaps, have force if this Court had not found that the Richardson valve was a good and desirable valve, and that the Webster valve was not a good and desirable valve until after persons acquainted with the Richardson valve had worked upon it and caused it to simulate the Richardson valve.

The matters of fact found in the principal case cannot be varied on an accounting, indirectly, any more than they can be varied directly, unless the case is reheard on the principal proceeding or on a bill of review. In this case the matter has been heard by this Court, and a petition for rehearing was filed and overruled, and the case sent to the Master by a mandate which reads in part as follows:

"It is further ordered that this cause be, and the same is hereby, remanded to the said circuit court with direction to enter a decree sustaining the validity of the patent of 1866 sued on, and decree an infringement, and award an account of profit and damages as prayed for, and to take such further proceeding as may be proper and not inconsistent with the opinion of this Court."

Is it or not inconsistent with the opinion of this Court to prove that the Webster valve was a good valve? The opinion says:

"Ritchie gives no information how to make a

valve work at a predetermined pressure or how to make it work with a small range of difference between the opening and closing pressures, or how to proportion the strength of the spring and the size of the stricture to each other. The same thing is true of the Webster and Hartley patents. The Webster patent shows a huddling chamber and a stricture, but the evidence shows that valves made with the proportion shown in the drawings of the Webster patent work with so large a loss of boiler pressure before closing as to be practically and economically worthless."

It says on page 170:

"Richardson was the first person who described and introduced into use a safety valve which, while it automatically relieves the pressure of steam in the boiler, did not, in effecting that result, reduce the pressure to such an extent as to make the use of the relieving apparatus practically impossible because of the expenditure of time and fuel necessary to bring up the steam again to the proper working standard. His valve, while it automatically gives relief before the pressure becomes dangerously great, according to the point at which the valve is set to blow off, operates so as to automatically arrest, with promptness, the reduction of pressure when the boiler is relieved."

There is no evidence in the proceeding before the Master, and there is not pretended to be any evidence anywhere, that Richardson was not, as found by this Court in 1885, the first inventor and introducer of the safety valve which automatically opened

when the boiler pressure became dangerously great and automatically closed promptly when a small loss of working pressure had been blown away—this small loss being defined as a loss of from three to five pounds on a pressure of 130, or from about 2½ to somewhat less than 4 per cent. of the initial pressure.

It is undoubtedly true that Richardson's invention did revolutionize the art of steam engineering in this respect; but the contention of the defendants and appellants is that this Court has so construed the Richardson patent that it is not a patent for a valve which can really do that thing. It is clear upon the evidence before the Master that if these valves, which are said to be bad valves made after the drawings and directions of the Richardson patent, have their stricture slightly altered from what the appellants' experts say they appear to be in the drawings, and to which Mr. Forbes says the drawings show, they become useful and commercial valves, and operate exactly as is described in the opinion of this Court; and it is also true, as this Court formerly said in the 113th U. S., page 171: "It is not shown that before 1866 any valve produced this result;" and page 174, "that neither Ritchie nor Webster nor Hartley [nor anybody else] gave any directions how to proportion the strength of the spring and the size of the stricture to each other."

The real discovery of Richardson was that the size of the stricture was a delicate micrometer adjustment for the working of the valve, and this dis-

covery was stated by him in simple language, that about 1-64th of an inch was a suitable size of stricture for an ordinary spring, and that it should be larger for a weak spring and smaller for a strong spring; and this discovery, so carefully stated in the patent, is shown to be absolutely true in fact, by the experiments in this case.

The appellants utterly failed to show that the Webster valves had a commercial value or commercial use, and consequently failed to furnish a standard of commercial comparison, which is the only comparison on which a commercial question of profits can be computed. They in substance say: "We might have used this valve, but we didn't; somebody else might have used this valve, but nobody ever did use it; and if we had used it and had tried it in practice and it had turned out right, then we should have made less money out of our Crosby valves, and therefore the recovery against the 24,000 Crosby valves should be reduced to nothing."

The appellants admit that, on their construction of the Richardson patent, the Crosby valves embodied that patent and could not work at all without embodying it, and they claim that it was the only valve which did embody it, and therefore having made 24,000 of them they should be allowed to go free, because they and they only ever made use of what they say was the construction patented to Richardson.

Defendants have served a supplemental brief which contends that the profits realized by the de-

fendants between 1879 and September 25, 1883, shall be apportioned between the Richardson patent of 1866 and the Richardson patent of 1869; and this notwithstanding the fact that the Master reported, and the court below has found, that the defendants realized no profits from their employment of the Richardson patent of 1869 in their valves, either before the date of September 25, 1883, or since that date; and this upon the testimony of Mr. Eager (Record, p. 208, interrogatory 32), that "the change from adjustability to non-adjustability in the Crosby valve had no effect. The appellants filled their contract orders and new orders with the non-adjustable valve without complaint, and were able to and did extend their trade in valves;" and that (interrogatories 33 and 34) "he never knew of the use of the adjustable feature of the Crosby valve by a customer; that after years of use the valves came back with the same adjustment which they originally had when they left the factory; and that the adjustable feature was of no consequence in the railroad trade." And page 209, cross-interrogatory 46: "The adjustable feature was not considered of any importance except as a shop convenience." And page 210, cross-interrogatory 48: "That the adjustable feature sometimes caused trouble in the hands of ignorant engineers, and that for two years before the decision of this Court the directions about adjustment of the valve had been erased or modified."

The Master said concerning this, that the defendants' claim that the adjustable device shown in the

Richardson patent of 1869 is worthless as such, and that the cost of the Crosby valve is less without the so-called adjustable ring, and is a better and more useful safety appliance (page 15.)

The court adopted concerning this (page 353) the exact language of the Master. The court below say (page 354):

"In number 1,199 complainants have filed several exceptions. They except to the finding of the Master that he had no means of determining from the evidence what portion of the defendants' profits were attributable to the use of the Richardson patent of 1869; and they further except to the finding of the Master that the defendants had made only nominal profits from the infringement of the 1869 patent, and the complainants have suffered only nominal damages from said infringement. Down to the expiration of the Richardson 1866 patent, or until September 25, 1883, the complainants contend in the case brought upon that patent that all the profit of the defendants was due to that patent, and the Master so found. If the 1869 patent contributed more than a nominal value to the defendants' infringing of valves during the operation of the 1866 patent, it was the duty of the complainants to have shown that fact in the suit upon the 1866 patent, and to have allowed a corresponding reduction in the finding of profits in that suit. After contending for and accepting such a finding, that the complainants were entitled to all the profits of this infringement of the 1866 patent by the manufacture and sale of valves containing the Richardson invention of 1866 and 1869, they cannot be permitted upon a bill of complaint against the same defendants to recover

more than nominal profits or damages for the infringement of the 1869 patent only."

This statement by the court leaves untouched one point in the contention of the complainants about the 1869 patent. The complainants contended that all the profits and all the damages during the period of the 1866 patent apply to the 1866 patent, but that on the expiration of that patent the right of the owners of the 1869 patent to collect for its use accrued; and the reason for this contention was that the 1869 patent could not be used in any valve without employing the 1866 patent as well; and therefore during the life of the 1866 patent it was a mere appendage, and did not have an independent existence until the expiration of the 1866 patent.

This contention appears on page 114, where it is said that the profits of the valve business between February 19, 1879, and February 24, 1883, are to be assessed in case 1,184, and that the profits of the valve business from September 25, 1883, to January 31, 1885, are to be assessed in case 1,199.

The Court, having found in a considered judgment in a case between these same parties on the patent of 1869 that neither profits nor damages are due to the complainants and appellees for the use of that patent of 1869 by the defendants and appellants, they cannot in this case go counter to that judgment and contend that some portion of the profits of the business were due to the use of that patent, where the